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SCIENTIFIC AND TECHNICAL



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ILLUSTRATED & DESCRIPTIVE



CATALOGUE



OF

Standard, Self-Recording,

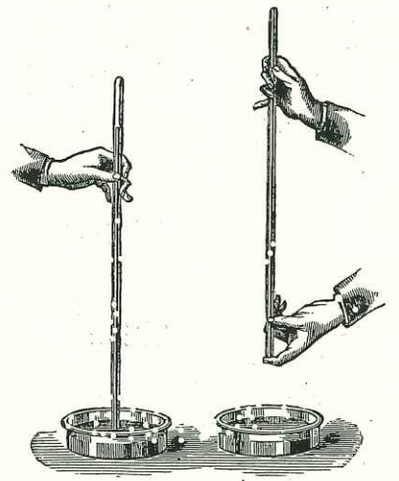
AND OTHER

METEOROLOGICAL

INSTRUMENTS,

AND ALL KINDS OF

CHEMICAL AND PHILOSOPHICAL APPARATUS,



C

[TORRICELLI'S First Experiment 1643.]

MANUFACTURED BY

JAMES J. HICKS, 1879

Meteorological Instrument Maker to the Admiralty and the Board of Trade, the Governments of India and Russia, the Royal Observatories of Greenwich and Kew, the Universities of Oxford and Cambridge, and the Meteorological Society,

8, HATTON GARDEN, LONDON, E.C.

FIVE SHILLINGS.

Agent: Walter Allen 633 F St N.W. Washington, D.C.

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OXFORD STREET, W.

INTRODUCTION.

In submitting this Catalogue to his patrons at home and abroad, J. J. Hicks desires to state that it has been his endeavour to make it comprehensive, and inclusive of all recent improvements.

By adopting the principle of division of labour, and a special organisation of the departments under experienced foremen, he is enabled to test each instrument of precision before its sale, and by his daily supervision, and personal labours at the Works, to ensure that accuracy, without which, instruments for meteorological observation are worthless.

Reference is made with satisfaction to the fact of the large Standard Barometer at the Royal Kew Observatory having been made and filled by him, and he desires to assure his patrons that the same skill which enabled him to make this exceptionally perfect tube is daily exercised in producing instruments of precision at his own Factory.

In connection with the *graduation* of Barometer Scales, most marked improvements have recently been made, resulting in such a complete correction for "errors of capacity" (well known to be inherent in every instrument), as to render his better class of Pediment Barometers almost equal to Standards.

The reputation for delicacy of manipulation which he has acquired has induced an increased demand for his Clinical Thermometers, now so largely used by the Medical Profession, who, with their accustomed discrimination, fully appreciate the high degree of excellence pertaining to the indications of these important aids to clinical investigation.

As further illustrative of the high character of his instruments, he has the gratification of announcing that the Standard Thermometer Tubes issued by the Royal Kew Observatory to the various Foreign Governments and Home and Foreign Observatories are entrusted to him to manufacture.

Among recent novelties of his invention and manufacture, J. J. Hicks would direct attention to the following :—

New Solar Radiation Thermometers, in which the perfection of the Vacua is tested by a Ruhmkorff Coil, and an amount of exhaustion produced to within 1-20th of an inch of perfection.

New "Cylinder Jacket" Minimum Thermometer, for Terrestrial Radiation, in which a degree of sensibility has been attained equal to mercury.

Highly Sensitive Thermometers, in which one degree of Fahr. extends to two or three inches on the scale.

Electric Alarm Thermometers, adjustable to any temperature, and giving alarm of fire by battery and bell.

A very delicate **Hydrometer,** for Testing Sea Water, having a very open scale specially graduated, and so weighted as to make the same stem act as four Hydrometers.

A New Patent Water Gauge for Steam Boilers, offering exceptional facilities for seeing the height of the water.

Each of the above instruments will be found described in detail in their respective classes.

Country and Foreign Orders should be accompanied by a remittance or Draft, payable in London.

J. J. Hicks begs to assure his Customers that every possible precaution is adopted in packing his goods, and that he employs only packers of long experience; he cannot, therefore, hold himself responsible for damage during transit.

Goods Shipped with the usual precautions as to Insurance, Consular Certificates, &c., unless otherwise instructed. Explicit directions as to mode of shipment, route, &c., should accompany all Orders from Abroad.

SELF-RECORDING INSTRUMENTS.

By the publication, in 1867, of the first Report of the Meteorological Committee of the Royal Society, a considerable impetus was imparted to the manufacture and use of Self-Recording Meteorological Instruments, and, since that time, the demand has so steadily increased that a brief reference to their general characteristics will appropriately precede the descriptions of the instruments themselves.

The conditions essential to the production of an Automatic Record are :—

1. Absolutely continuous, or intermittent Recording Apparatus.
2. A prepared surface to receive the Record.
3. A mechanical or chemical means of Imprinting the Record.
4. A Time Scale.
5. A Zero Line.

(1) The absolutely continuous and unbroken recording line is produced on sensitized photographic paper* (revolved by clockwork) by an arrangement of lamps and condensing lenses, and is used in the Thermograph, Magnetograph, and one form of Barograph.

The intermittent line is the result of a pencil or perforating point being brought, by clockwork, into hourly contact with the receiving surface.

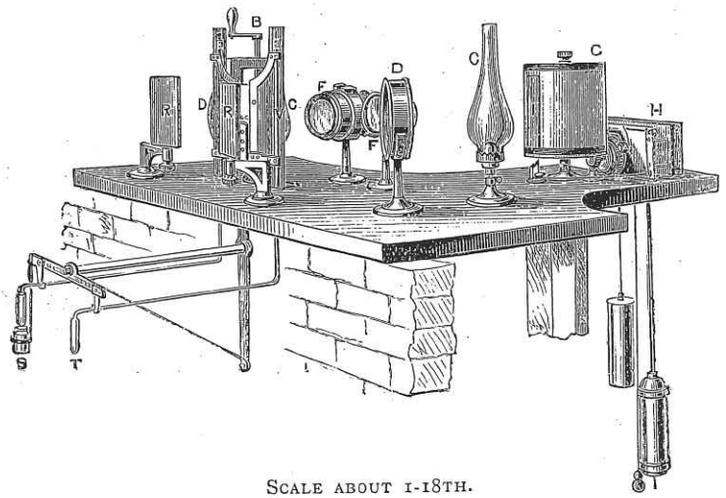
(2) The prepared surfaces consist of photographic paper, parchment paper, and a third, specially pure paper; the last two being ruled with horizontal lines, to show inches and tenths, and vertical lines to indicate the hours.

(3) The means of imprinting the record are either a spiral brass pencil twined on a cylinder, a black lead pencil, or a metallic perforating point brought, by clockwork, into contact with the receiving surface, either hourly, or at any convenient interval.

(4) The Time Scale is, in some cases, printed as described in paragraph 3; or, when the receiving surface is a photographic one, a shutter intercepts the light four minutes every two hours, which leaves a white line on developing the image.

(5) The zero line is produced on the photographically prepared paper by an arrangement of lenses condensing a beam of light on the bottom of the receiving surface, thus producing a horizontal line, from which the varying height of the curved line may be measured. The printed papers bear, not one, but many horizontal lines, indicating inches and tenths.

* This paper is supplied ready for use, with directions for developing. The manipulation is easily acquired.



SCALE ABOUT 1-18TH.

THERMOGRAPH
AND
SELF-RECORDING HYGROMETER, £82.

As adopted by the Meteorological Committee of the Royal Society.

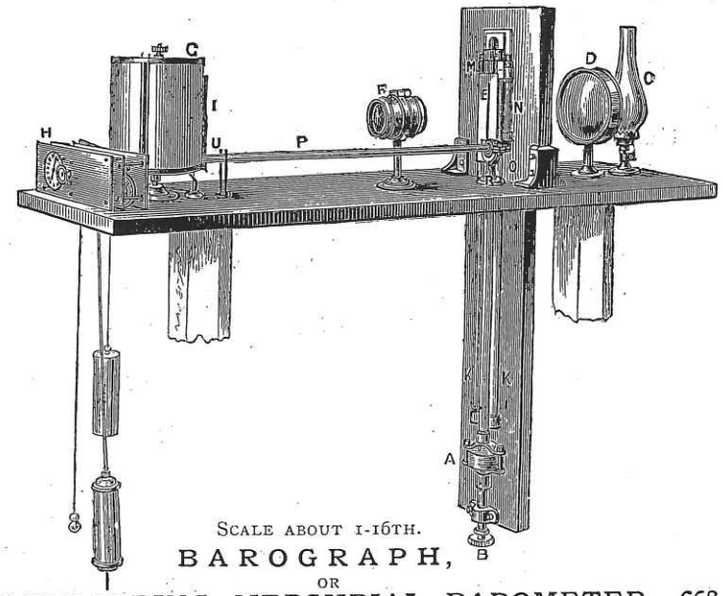
The thermometric and hygrometric records, which this instrument is designed to produce, are largely aided by photography. While, therefore, the bulbs of the Thermometers are necessarily placed in the open air, and at a suitable distance from any wall or other radiating surface, the tubes are of sufficient length to admit of their being brought inside the building, in due proximity to the recording apparatus placed in a chamber from which daylight is rigidly excluded.

The essential conditions in such an apparatus are:—

1. A means of denoting the height (in relation to a fixed horizontal line) of the mercurial column in the stem of a Thermometer.
2. A time scale denoting the exact moment at which the atmosphere reached the temperature indicated by the mark.
3. As the marks are produced chemically, and not mechanically (as in the Anemograph), a *dark* room.

A description of the drawing will show how efficiently, through the ingenuity of Mr. BECKLEY, these conditions have been obtained:—

S Wet bulb Thermometer.
T Atmospheric ,,
B Screw for adjusting Thermometers.
C C Paraffin lamps or gas-lights.
D D Condensers, concentrating the light on the mirrors R R.
R R Mirrors reflecting light through air-speck in Thermometers V V.
E E Slits through which light passes from mirrors R R.
F F Photographic lenses, producing image of air-speck from both Thermometers on cylinder G.
G Revolving cylinder or drum carrying photographic paper.
H Clock, turning cylinder G round once in 48 hours.
I Shutter to intercept light four minutes every two hours, leaving white time-line on developing latent image.



SCALE ABOUT 1-16TH.

BAROGRAPH,
OR
SELF-RECORDING MERCURIAL BAROMETER, £68.

As adopted by the Meteorological Committee of the Royal Society.

The following is a description of the cut:—

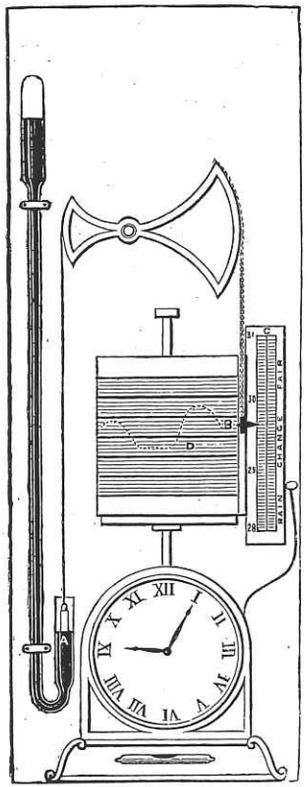
A Mercurial Barometer.
B Screw for adjusting Barometer to required height.
C Gas or paraffin lamp.
D Condenser, throwing light over top of mercurial column and through slit E.
E Slit through which light passes from gas-light C.
F Photographic lens, producing on cylinder G an image of the upper portion of the slit E, through which light has passed over the mercurial column.
G Cylinder bearing the sensitive paper.
H Clock, turning cylinder G round once in 48 hours.
L Shutter cutting off light from paper four minutes every two hours, thus producing white time-line, on developing photographic result.
K K Two zinc rods fastened to vertical slate at L, and sliding at M, connected with a glass rod N, which rests on one end of a glass lever O, indicating thermometric changes by expansion and contraction.
P Glass lever, moving on a fulcrum R, and supporting the end of the glass rod N at O, with a brass plate fixed on the other end U. This brass plate, being attached to the glass rod P, which is in connection with the zinc rods K K, rises and falls with every thermometric change, and in doing so exposes more or less of the lower portion of the photographic paper to the action of light falling on it through the slit E, so that barometric changes due to temperature only are indicated on the lower line, which, if such changes are considerable, becomes undulating instead of straight.

ADMIRAL MILNE'S

SELF-RECORDING MERCURIAL BAROMETER.

£17 10s.

This instrument is stated by the late Admiral FITZROY to "show the alterations in tension, or pulsations, so to speak, of atmosphere, on a large scale, by hourly marks; and the diagram expresses, to a practised observer, what the indicator card of a steam-cylinder shows to a skilful engineer, or a stethoscope to a physician."

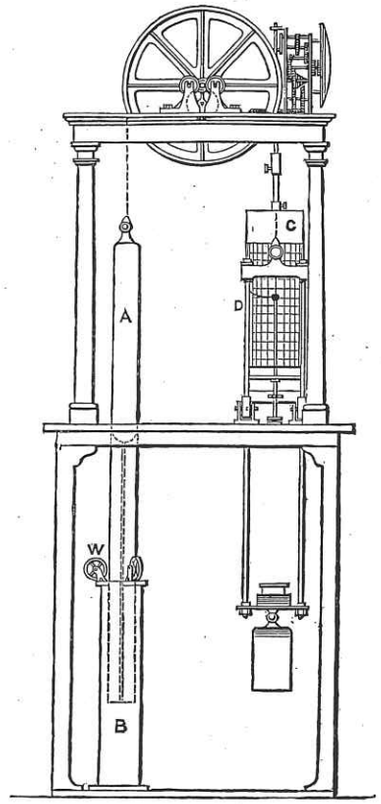


SCALE ABOUT 1-10TH.

In construction it greatly resembles a Wheel Barometer, being furnished with a syphon tube of large diameter, also a float, wheel and pointer; the float being duly counterpoised, and having an attached chain passing over the wheel carrying a recording pencil, which, by suitable mechanism, is brought once every hour into contact with suitably ruled paper, mounted on a drum revolved by clockwork. In this manner the instrument becomes self-recording; and, as the paper is ruled into inches and tenths, to correspond with the Barometer scale, and divided vertically into a sufficient number of 12-hour spaces to last a week, it is only necessary to renew the paper once during that interval. The whole apparatus is enclosed with a Self-Registering Maximum and Minimum Thermometer, in a polished walnut or mahogany case, to protect it from dust.

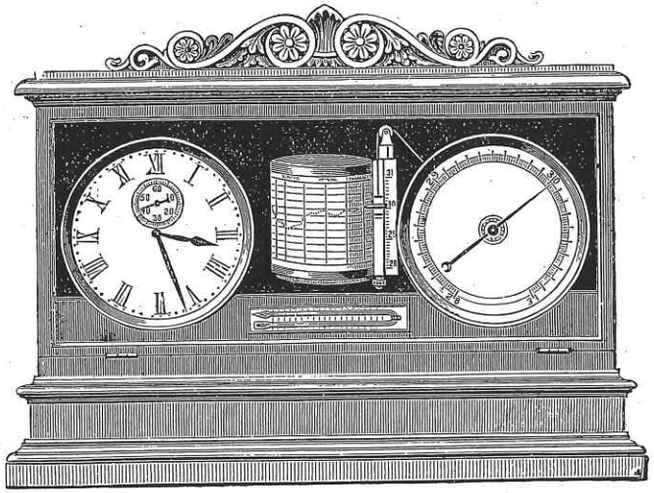
KING'S SELF-RECORDING BAROMETER.

This instrument, the invention of Mr. ALFRED KING, Engineer of the Liverpool Gas Company, is in use at the Liverpool Observatory, where it yields results of a highly satisfactory character.



SCALE ABOUT 1-12TH.

The accompanying Figure shows the relative positions of the various parts. A is the Barometer tube, made, in this instance, of steel, and having an internal diameter of three inches; it floats freely in the fixed cistern B, guided by friction wheels W. This tube is attached to a short-linked metal chain, which passes over a grooved wheel turning on finely adjusted friction rollers. The frame D is suspended, with its recording apparatus and weight, to the other end of the chain, and thus forms a counterpoise to the Barometer tube. The cylinder C is covered with ruled and divided tracing paper, and revolves *once in* 24 *hours*, thus producing the result described by Mr. HARTNUP, the Director of the Liverpool Observatory, who says:—"For one inch change in the mercurial column the pencil passes through five inches, so that the horizontal lines on the tracing, which are half an inch apart, represent 1-10th of an inch change in the Barometer. The vertical lines are hour lines, and, being nearly three-quarters of an inch apart, it will be seen that the smallest appreciable change in the Barometer, and the time of its occurrence, are recorded."



SCALE ABOUT 1-8TH.

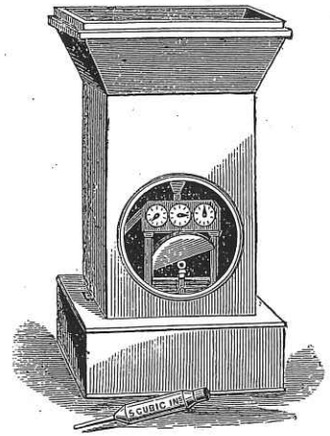
BAROGRAPH,
OR
SELF-RECORDING ANEROID BAROMETER,
£21.

Self-Recording Aneroid Barometer.—This instrument is designed to show the fluctuations which may have taken place in the Barometer in the interval between any stated hours of observation. It consists of an Aneroid Barometer and an eight-day clock, each with 8-in. dials, between which is placed a vertical cylinder four inches in diameter, having a paper attached to it ruled to coincide with the Barometer scale. It is also divided vertically into seven principal and seven minor divisions, indicated by darker and lighter lines. The dark lines represent the noon, and the lighter lines the midnight of each 24 hours. The paper thus lasts one week, the cylinder turning on its axis once in that time. Near the paper, a pencil, guided by a metal rod, is moved up and down as the action takes place in the Aneroid, and at every hour the pencil is made to mark the paper by simple mechanism connected with the clock.

By this means a dotted curved line is produced, showing at a glance the height of the Barometer—whether it is falling or rising, for how long it has been doing so, and at what rate the change is taking place—whether at the rate of 1-10th per hour, or 1-10th in 24 hours—facts which can only be obtained by very frequent and regular observations from an ordinary Barometer, but which are nevertheless essential to a reliable "weather forecast."

The instrument has the advantage of freedom from complication, and is designed especially to suit the general public; it is handsome in appearance and not easily put out of order, being admirably adapted for public libraries, the reading rooms of clubs, &c., as well as for use by meteorological observers generally.*

* *The Aneroid Barometer: How to Buy and how to Use it.* By a Fellow of the Meteorological Society. Post free for six stamps, or 4/3 per dozen.



SCALE ABOUT 1-10TH.

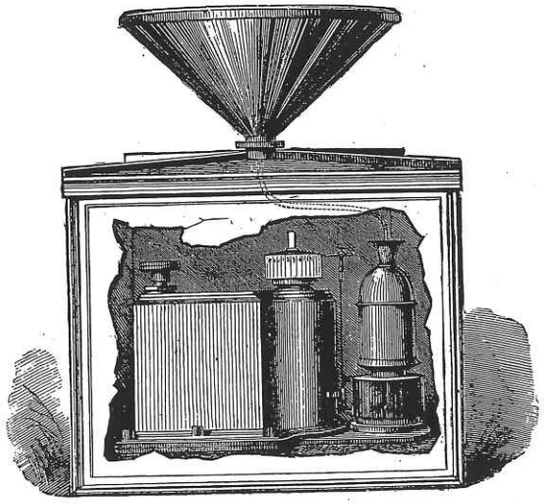
PLUVIOMETER,
OR
SELF-REGISTERING RAIN GAUGE, £4 10s.
(CROSLEY'S.)

The engraving at the head of this page shows the form, and part of the details of construction, of this economical Registering Pluviometer, which is recommended by its inventor to be placed on an ornamental pedestal three feet high, in an open situation, where no trees or buildings will obstruct the rain, such situations being frequently found in lawns or gardens.

In the present case, the receiving surface, being 10 inches square, includes an area of 100 square inches; and the rain collected within this area falls down the sloping sides, through a grating, into a funnel, which conducts it to the vibrating bucket, the motion of which (from side to side), as it successively discharges its load of rain, acts on a train of wheels moving index hands over three dials, thus registering inches, 10ths, and 100ths. It is important to note that the centre index moves in a direction contrary to the other two, the dial being duly figured to show the direction in which it does move. Under this unavoidable arrangement it is easy to fall into the error of reading *six* for *four*, as in the 10ths dial, unless special care be taken.

The record of each day's fall should be made in a book and tabulated once a month, to obtain the total rainfall for the year.

Should the instrument become deranged from any cause, its accuracy is tested by a small measure supplied with it, and containing, when filled to the brim, exactly five cubic inches, which, when passed through, should move the hand of the circle of 100ths five divisions, or half-way round the scale, being equivalent to half a 10th of an inch.



SCALE ABOUT 1-7TH.

BECKLEY'S PLUVIOGRAPH,

OR

SELF-RECORDING RAIN GAUGE, £36.

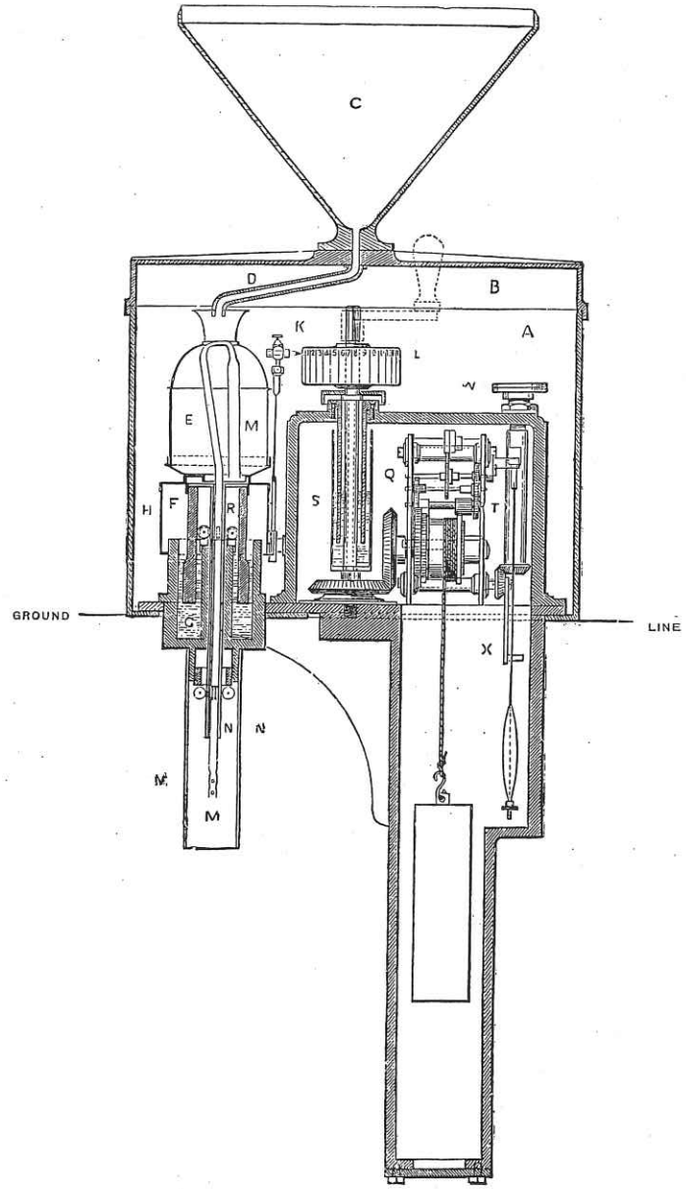
HICKS' Patent, as used at the Meteorological Stations.

This instrument possesses the exceptional merit of recording with equal precision all rain-falls, from a slight summer shower to a heavy storm of rain. It requires no special erection, and may be placed in a hole in the ground, with the receiving surface raised only a few inches above its level.

The perspective view on this page, and the accompanying sectional engraving (p. 13), illustrate the construction of the instrument, a detailed description of which, with instructions for use, is furnished to each purchaser.

The funnel C has a receiving surface of 100 square inches, protected by a lip $1\frac{1}{4}$ inches deep, to retain the splashes. The rain flows into the copper receiving vessel E, which, floating in a cistern of mercury G, sinks and draws down with it the pencil K, which records the event on a cylinder L, covered with waterproof paper and moved by the clock Q. When the receiving vessel is full the syphon M comes into action, rapidly drawing off *the whole* of the water, the vessel rising almost at a bound, the action being recorded by a vertical line on the cylinder. The prepared paper, bearing the time scale, should be renewed once in every 24 hours, which may be readily done by raising the hinged lid of the cast iron box A.

Precautions are adopted to prevent injury to the clock and delicate portions of the instrument, from moisture, by adopting mercurial socket joints, which allow freedom of motion while they exclude the air. The whole outer casing and turned and enamelled funnel are of cast iron.



SCALE ABOUT 1-6TH.

BECKLEY'S PLUVIOGRAPH,

OR

SELF-RECORDING RAIN GAUGE, £36.

HICKS' Patent, as used at the Meteorological Stations.

Self-Recording Rain Gauge by the Rev. E. STUTTER (*see Appendix*).

ANEMOGRAPH,
OR
SELF-RECORDING WIND GAUGE,* £70.

As adopted by the Meteorological Committee of the Royal Society.

The purpose of this instrument is to register the velocity and direction of the wind from day to day. It is the form designed and arranged by Mr. BECKLEY, of the Kew Observatory, and has been adopted by the Board of Trade.

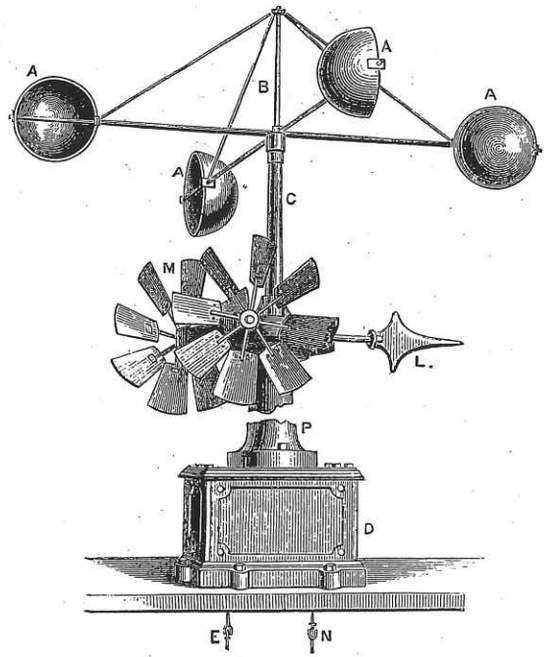
It consists, first of a set of hemispherical cups and vanes, which are exposed on the roof of the house; and, secondly, of the recording apparatus, which may be placed in the hall or library, or elsewhere inside the house.

The motion imparted to the hemispherical cups by the wind is communicated to the steel shaft B, which, passing through the hollow shaft C, and having at its lower end an endless screw, works into a series of wheels in the iron box D, which reduces the angular velocity 7000 times. At the required distance the motion, having emerged at E, is connected with F, where, by means of bevelled wheels, it moves the spiral brass registering pencil C, which is arranged so that each revolution records 50 miles of velocity on the prepared paper H.

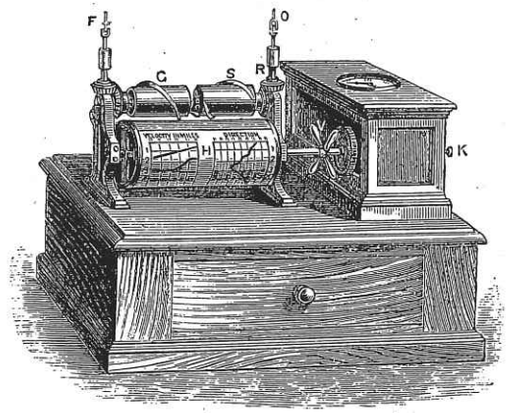
The direction of the wind is indicated by the arrow L, which is kept in position by the fans M. These communicate, by an endless screw and train of wheels, through the shaft C and the box D to the recording apparatus, which consists of a spiral brass pencil, which in one revolution records variations through the cardinal points of the compass, on the same prepared paper as that which receives the record of velocity.

The paper is held on the drum by two small clips, and may be readily changed by unclamping the cross V, without disturbing the drum or any other part of the instrument.

* Special Estimates where the Recording instrument is placed on any floor below that nearest the roof.



Portion for Exterior of Observatory.

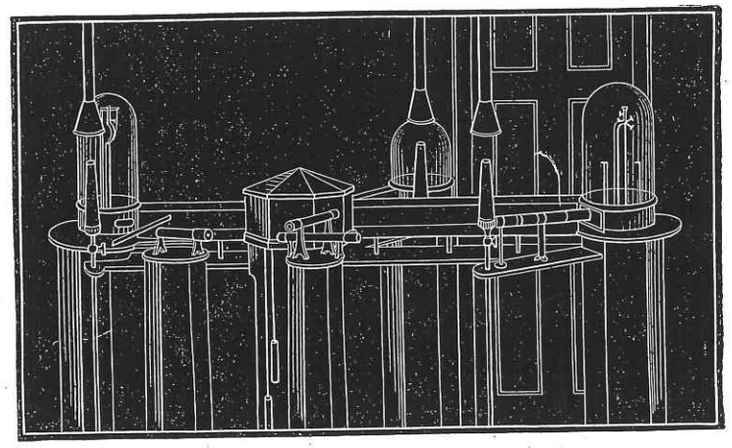


Portion for Interior of Observatory.

SCALE ABOUT 1-20TH.

ANEMOGRAPH,
OR
SELF-RECORDING WIND GAUGE, £70.

Registering inside the dome, or roof. If Recording apparatus be placed on any floor below this, a proportionate increase of price will be charged.



SCALE ABOUT 1-12TH.

MAGNETOGRAPH,
OR
SELF-RECORDING MAGNETOMETER,

As adopted by the Meteorological Committee of the Royal Society.

The relative positions of the various parts of this apparatus may be realised by a glance at the illustration, aided by a brief description.

It is well known that the direction and intensity of the earth's magnetism is constantly varying, and by means of this arrangement these variations, as indicated by the oscillations of three magnets, are recorded on photographically prepared paper, stretched on a drum revolved by clockwork.

The magnet, which is to the left in the sketch, is suspended in the magnetic meridian by a silk thread, and, by the aid of a mirror attached, it describes on the cylinder, moved by clockwork in the centre pier, all the variations in the magnetic declination.

The other two components of the magnetic force of the earth are given by the other magnets. That recording the vertical variations rests on two agate edges under the glass shade nearest the doorway, while the horizontal component magnet is suspended by a double steel thread, under the shade to the right of the picture, being retained by the tension of the thread in a position nearly at right angles to the magnetic meridian.

The clock box in the centre covers the three revolving cylinders bearing the sensitive photographic paper, and to each magnet is attached a semi-circular mirror, which reflects the rays from a gas jet to one of the cylinders, and thus describes by a curved line the oscillations of the magnet. A second semi-circular mirror is *fixed* to the pier on which the instrument stands, and consequently describes a straight line, or zero, from whence the curves are measured.

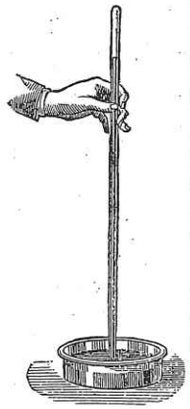
To avoid errors attending sudden changes of temperature, underground vaults are always chosen for magnetic observations, and also on account of light being more easily and perfectly excluded.

The arrangement figured and described above was made by Mr. BECKLEY, and is at present in use at the Kew Observatory.

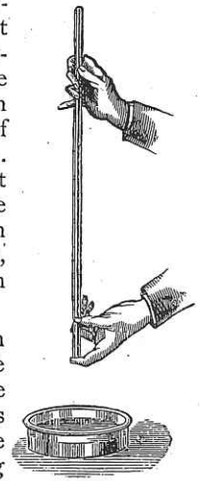
THE BAROMETER.

The first Barometer was invented by TORRICELLI, a Florentine, in 1643, and in so perfect a form that in its essential features it has not been superseded. It is matter for regret to know that the illustrious inventor died only four years after, at the early age of 39 years, having made himself for ever famous by the invention of an instrument the usefulness of which it is impossible to over-estimate.

The illustrations show the mode of constructing a Barometer in its simplest form. It consists in hermetically sealing a glass tube about three feet long and filling it with mercury. The finger is placed over the open end of the tube, which is then inverted and placed in a cistern of mercury and the finger withdrawn. The left hand figure shows the result—the mercury is seen to fall some three or four inches, leaving an empty space at the top of the tube, which is called the "Torricellian vacuum."



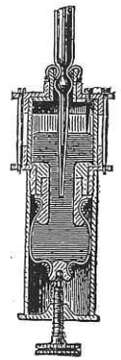
1.
SCALE ABOUT 1-18TH.



2.
SCALE ABOUT 1-18TH.

The mercury is prevented from falling lower than is shown, by the external pressure of the atmosphere on the mercury. The *weight* of this column, therefore, represents the *weight* or pressure of a corresponding column of air many miles in height; and so close is the relation between the column of mercury and the external air that the *height* of the former changes with the slightest variation in the *weight* of the latter, and the instrument thus becomes a measure of the weight of the air, from which property its name is derived: the Greek words *baros* and *metron*, signifying respectively "weight" and "measure."

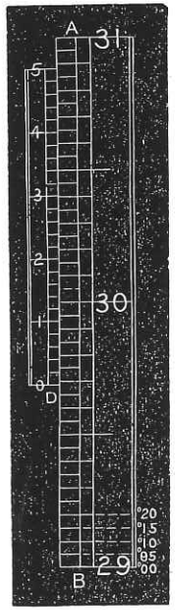
Fortin's Barometer.—When the mercury in the Barometer tube falls, that in the cistern rises in corresponding proportion, and *vice versa*, so that there is an ever-varying relation between the level of the mercury in the tube and the mercury in the cistern, which affects the accuracy of the readings. M. FORTIN'S form of cistern completely obviates this difficulty, by making the cistern of glass, with flexible leather bottom and a brass adjusting screw, as shown in the cut. Through the top of the cistern is inserted a small ivory pointer, the lower end of which corresponds with the zero of the scale; and, in order that the readings should possess uniform value, it is necessary, at each observation, that the level of the mercury in the cistern should be adjusted by the screw until the ivory point appears to touch its own reflection on the surface. The reading is then taken.



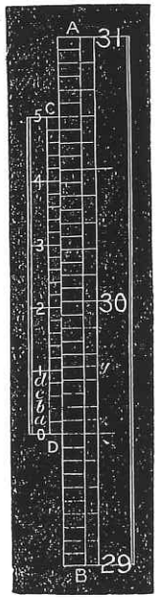
3.
SCALE ABOUT 1-6TH.

THE VERNIER.

The Vernier is a moveable scale for subdividing parts of a fixed scale, and was first applied to that purpose by its inventor, M. PIERRE VERNIER, in 1630. In the Barometer the parts to be divided are inches, which, by the aid of this invention, are subdivided into 10ths, 100ths and 1000ths.



4.



5.

Fig. 4 shows the scale of a standard Barometer divided into ½-10ths, or ·05 of an inch. The Vernier C D is made equal to 24 of such divisions, and is divided into 25 equal parts, from whence it follows that one division on the scale is 1-25th of ·05 larger than one on the Vernier, so that it shows a difference of ·002 of an inch. The Vernier reads from ·0, or zero, upwards; D, therefore, indicates the top of the mercurial column.

In Fig. 5, zero on the Vernier is exactly in line with 29 inches and 5-10ths of the fixed scale; the reading, therefore, is 29·500-inch. The Vernier line *a* falls short of a division of the scale by ·002-inch; *b*, by ·004; *c*, by ·006; *d*, by 008; and the succeeding line by 100th. If the Vernier be adjusted to make *a* coincide with *z* on the scale, it will have moved through ·002-inch; and if 1 on the Vernier be moved to coincide with *y* on the scale, the space measured will be ·010-inch. Consequently, the figures 1, 2, 3, 4, 5, on the Vernier, measure 100ths, and the intermediate lines even 1000ths of an inch. In Fig. 4 the zero of the Vernier is between 29·65 and 29·70 on the scale. Glancing up the Vernier and scale, the second line above 3 will be found in a direct line with one on the scale; this gives ·03 and ·004 to add to 29·65, so that the actual reading is 29·684. In those instances where no line on the Verner is found *precisely* to coincide with a line on the scale, and doubt arises as to which to select from two equally coincident, the rule is to take the intermediate 1000th of an inch.

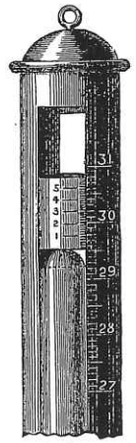
For household and marine Barometers such minute subdivisions of the scale are unnecessary, and the scales of such instruments are therefore divided only to 10ths, and the Verniers made only to read to 100ths of an inch, which is effected by making the Vernier 9-10ths or 11-10ths of an inch long and dividing it into 10 equal parts.

In "taking a reading" it is important that it should be done as quickly as possible, as the heat from the body and the hand is sufficient to interfere with that accuracy which is necessary where the intention is to compare the readings with those made by other observers. This facility is soon acquired by a little practice.

CORRECTIONS FOR CAPILLARITY, &c.

Correction for Capillarity.—Unless the diameter of a barometer tube exceeds 0·6 of an inch the mercurial column is always slightly depressed by the capillary attraction of the sides of the tube (6). The diameter of the tube being known, the following Table gives the corrections necessary to be *added* to the readings for the respective diameters:—

Diameter of Tube.	Depression in Boiled Tubes.	Depression in Unboiled Tubes.
INCH.	INCH.	INCH.
0·60	0.002	0·004
0·55	0·003	0·005
0·50	0·003	0·007
0·45	0·005	0·010
0·40	0·007	0·015
0·35	0·010	0·021
0·30	0·014	0·029
0·25	0·020	0·041
0·20	0·029	0;058
0·15	0·044	0·086
0·10	0·070	0·140



6.
SCALE ABOUT ½.

Correction for Temperature.—In making Barometric observations for comparison with others, it is necessary that all should be reduced to the common temperature of 32° F., and for this purpose a set of SIMMONDS' Tables will be found very convenient, as saving much time in calculation.

Correction for Elevation.—The little work above referred to contains also Tables for reducing observations of the Barometer to sea level, an operation equally indispensable with the other corrections, to make the readings intercomparable.

ENGLISH AND METRICAL SCALES OF BAROMETERS,

At all Temperatures common to both. By F. F. TUCKETT, Esq.

Inches.	Millimetres.	Inches.	Millimetres.
32	812·5312	16	406·2656
31	787·1396	15	380·8740
30	761·7480	14	355·4824
29	736·3564	13	330·0908
28	710·9648	12	304·6992
27	685·5732	11	279·3076
26	660·1816	10	253·9160
25	634·7900	9	228·5244
24	609·3984	8	203·1328
23	584·0068	7	177·7412
22	558·6152	6	152·3496
21	533·2236	5	126·9580
20	507·8320	4	101·5664
19	482·4404	3	76·1748
18	457·0488	2	50·7832
17	431·6572	1	25·3916

STANDARD BAROMETERS.

1. **Standard Barometer,** on FORTIN'S principle, with its tube, which is 0·75 inch bore, enclosed in a brass body, having at its upper end two vertical openings, in which the vernier works. The readings are taken through these openings, aided by light reflected from a white opaque glass reflector let into the mahogany board behind. The scale is divided on one side into English inches and 20ths, and on the other to French centimetres and millimetres, the vernier enabling a reading to be taken, in each case respectively, of 1-500th of an inch and 1-10th of a millimetre. In making the instrument, the mercury is boiled in the tube, to ensure the complete exclusion of air and moisture; while FORTIN'S principle of cistern ensures a constant level from whence to take the readings (Fig. 7).

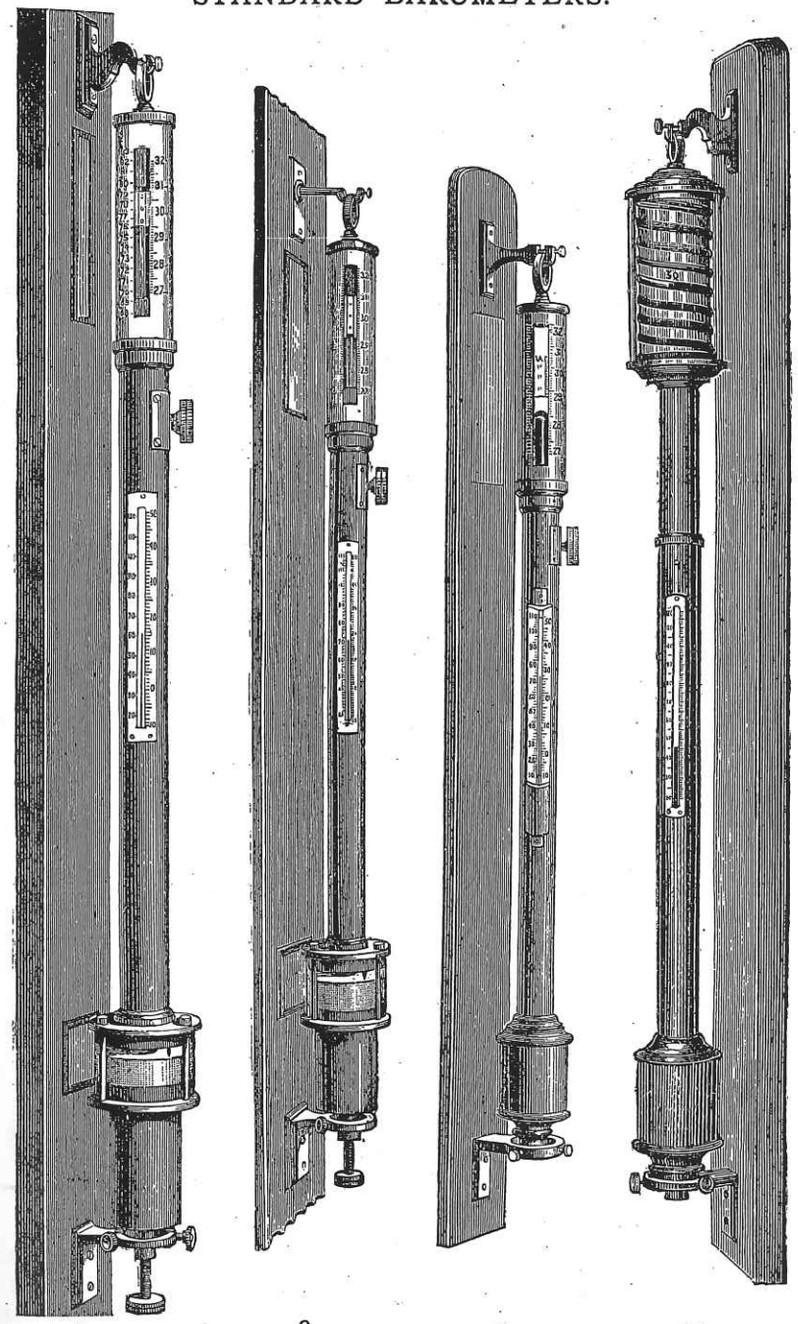
A highly sensitive Thermometer with scale, engine divided on stem, is attached to the brass mount, which is perforated to admit the attenuated bulb of the Thermometer into absolute contact with the glass tube of the Barometer, to ensure its indicating the same temperature as the contained mercury. The instrument is suspended by a ring from a brass bracket attached to a mahogany board; and the lower end passes through a larger ring having three screws for its vertical adjustment.

A "reading" is taken in the following manner:—1. Note the temperature by the attached Thermometer. 2. Raise or lower the mercury in the cistern by turning the screw underneath until the reflected image of the ivory point on the mercury seems to be in contact with the ivory itself. Adjust the vernier by the milled head until its lower edge just touches the top of the mercurial column, when scale and vernier will indicate the height of the Barometer in inches, 10ths and 100ths.

	£	s.	d.
	21	0	0
2. *Standard Barometer.—This instrument is of similar construction to No. 1, having a tube of 0·6 inch bore, and reading by the aid of a vernier to 1-500th of an inch and 1-10th of a millimetre. The tube is enclosed in brass, has an attached Thermometer of extreme delicacy, the whole suspended on brackets attached to a mahogany board	12	0	0
3. **Standard Barometer,** diameter of tube 0·5 inch (Fig. 8)	8	8	0
4. **Standard Barometer.**—The construction of this instrument is similar to No. 2. The internal diameter of its tube is ⅓rd-in., and the vernier reads to 1-500th inch.	7	7	0
5. **Standard Barometer.**—Smaller size, 3-10ths inch bore, and reading by aid of the vernier to 1-500th of an inch	6	0	0
6. **Standard Mountain Barometer,** on FORTIN'S principle, reading to 1-500th of an inch as No. 1 standard, with two verniers, one being a continuation of the other, the scale reading from 12 inches to 32 inches, mounted on metal tripod stand, packed in leather sling case, metal lined for strength (Figs. 13 and 14)	8	8	0
7. **Standard Mountain Barometer,** same as preceding, with millimetre scale extra	9	9	0
8. **Hick's Patent Short Tube Barometer,** specially constructed for balloon experiments or altitude measurements, by tourists and others, at elevated mountain stations .	3	5	0

* Extra for millimetre scale to Nos. 4 and 5, 21/-

STANDARD BAROMETERS.



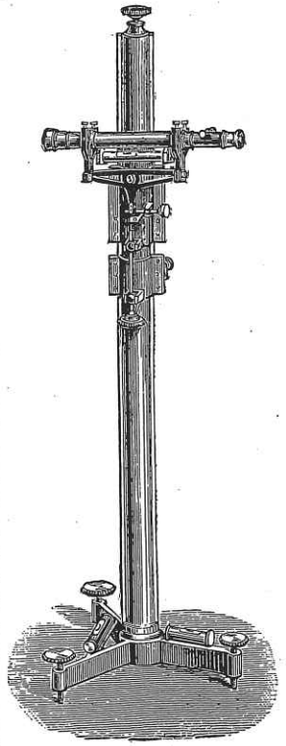
7. 8. 9. 10.

SCALE ABOUT 1-7TH.

STANDARD BAROMETERS.

	£	s.	d.
9. **Standard Barometer.**—Constructed on the Kew principle for meteorological stations. The tube is 0·5-inches in diameter, mounted in brass like the No. 1 Standard Barometer, with silvered scale and vernier reading to 1-500th inch, but having the graduations so arranged as to compensate for the rise and fall of mercury in the cistern, thus obviating the necessity for adjustment to the zero point before reading, as in the FORTIN principle. A Thermometer divided and figured on the scale is attached. It is mounted on mahogany board and is adjustable for light coming from any angle (Fig. 9)	6	6	0
10. **Standard Barometer,** constructed on the Kew principle as above, tube 3-10th's diameter, reading to 1-500th-in.	5	5	0

High class instruments, such as those here described, yield *exact* readings; but, in order to note them accurately, it is important that the eye, the zero edge of the vernier, the top of the mercurial column and the back of the vernier should be in the same horizontal plane, conditions which may be obtained after some practice, but which are secured beyond a doubt at the Kew Observatory, and wherever *absolute* accuracy is a *sine qua non*, by employing an instrument called a Cathetometer, of which the following is a description:—

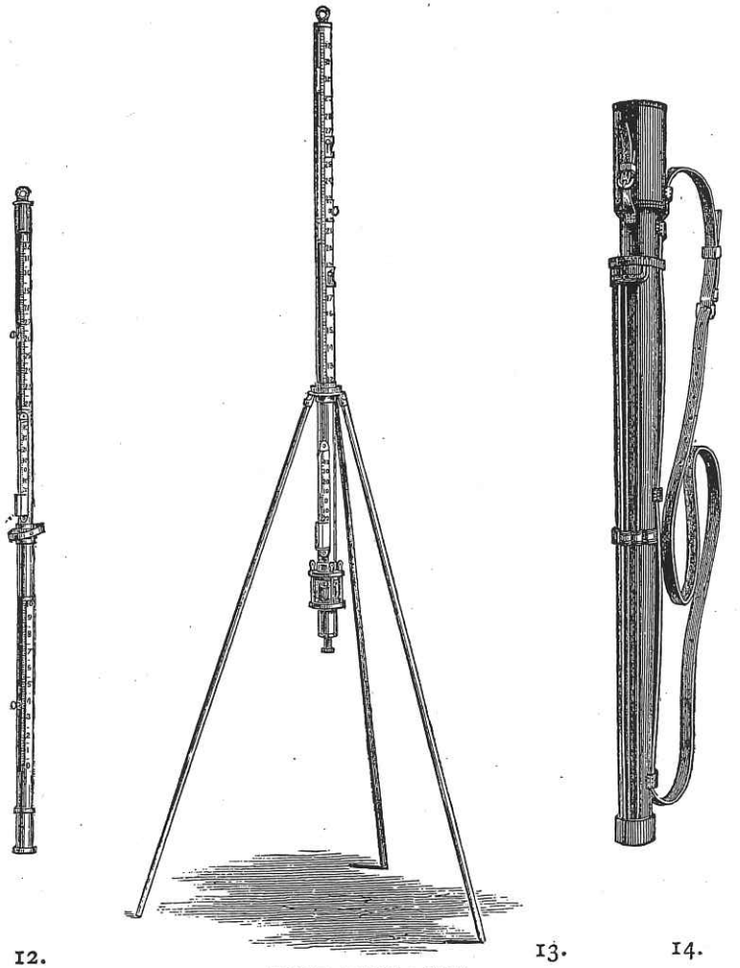


11.
SCALE ABOUT 1-12TH.

11. **The Cathetometer** is an instrument for measuring, with unerring accuracy, the difference of level between two points, and consists of a vertical stand bearing a scale graduated to read by a vernier to the 10000th part of an inch. The scale turns readily on a steel axis, which is fixed on a tripod furnished with levelling screws and two spirit levels at right angles to each other. A frame carrying a telescope with spider lines in the focus of the eye-piece moves up and down the scale, and can be fixed by means of a clamp and slow motion screw, with great precision, at any required height. The telescope resembles the optical portion of a theodolite, in being furnished with a spirit level and adjusting screws; and when it is desired to note the difference of level between the centre and sides of a mercurial column, all that is necessary is to sight them successively, and measure the distance passed over on the scale by means of the attached vernier (Fig. 11). £20 0 0

	£	s.	d.
12. **Standard Barometer,** to revolve on cast iron pedestal frame, as used at the Kew and other leading Observatories, internal diameter of tube 1 inch	24	0	0

A verification from the Kew Observatory is supplied with Standard Barometers compensated for capacity on the Kew principle, at a charge of 21/-



12. 13. 14.
SCALE ABOUT 1-12TH.

MOUNTAIN BAROMETERS.

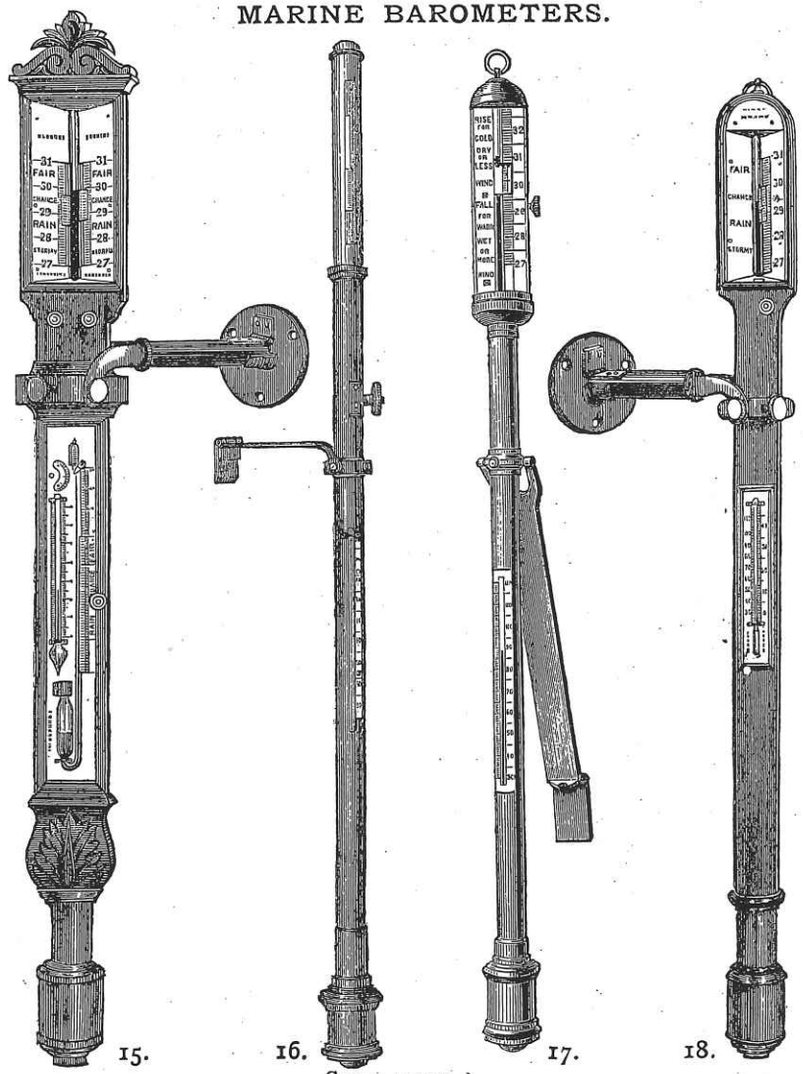
	£	s.	d.
13. **Mountain Barometer,** on FORTIN'S principle, ivory pointer in cistern, attached Thermometer, graduated on stem. Barometer tube enclosed in metal body, portable brass tripod stand and gimbals to revolve, packed in leather sling case, metal lined, for travelling (Fig. 13) . .	8	8	0
14. **Mountain Barometer,** on GAY LUSSAC'S principle, syphon tube and arrangement for exclusion of air, tripod stand and leather case. The metal tube enclosing glass tube is graduated from the centre, with double vernier, the sum of the two readings giving the correct height to 1-500th inch (Fig. 12)	5	5	0
14a. **Mountain Barometer,** like No. 14, without stand or leather case	5	0	0

These instruments have boiled tubes, and the GAY LUSSAC is corrected for capacity.

MARINE BAROMETERS, CASES, &c.

	£	s.	d.
15. **Standard Barometer** with extra large tube and cistern, internal diameter of tube 1 inch, arranged for observations being taken by the Cathetometer with extreme precision, as used at the Kew Observatory	25	0	0
16. **Glass Case** for Standard Barometer, plate glass sides and door, silvered plate glass reflector at back. . . .	4	0	0
17. **Glass Case** for Standard Barometer, plate glass sides and door, silvered plate glass reflector at back, for larger size Standard	5	15	0
18. **Glass Case** for Standard Barometer, of polished ebonized mahogany, glass front and sides, an efficient protection from dust	2	7	6
19. **Glass Case**, same as preceding, smaller size . .	1	15	0
20. **Glass Case** for Standard Barometer, of ebonised mahogany, &c., as preceding, with silvered plate glass back	3	0	0
21. **Glass Case**, same as preceding, smaller size . .	2	5	0
22. **Board of Trade Standard Marine Barometer**, on the Kew principle, with metal scale (compensated), as used by the Admiralty and the Meteorological Office, and recommended by the Brussels Conference. The cistern is of iron and the frame of brass, and is suspended by a stout but elastic brass arm in gimbals, to facilitate making correct observations at sea. The tube is contracted, to prevent oscillation during the heaviest storm. The scale reads to 1-500th inch (Fig. 17)	4	4	0
23. **Gun Marine Barometer** is constructed with especial reference to its employment in the Royal Navy during the discharge of the largest guns. It is found to withstand the most violent atmospheric concussions completely, and yield readings which, for accuracy, are not exceeded by the best Barometers (Fig. 16) . . .	4	4	0
24. **Marine Barometer** with attached Thermometer, ivory scales, double vernier, reading to 100-th inch, revolving in centre ring and gimbals, complete in mahogany, rosewood or oak, bow front	3	0	0
25. **Marine Barometer,** same as preceding, with single vernier	2	15	0
26. **Marine Barometer,** round top, attached Thermometer, ivory scales, double vernier, reading to 100th inch, with stout plate glass fronts, in mahogany, rosewood or oak .	2	7	6
27. **Marine Barometer,** same as preceding, with single vernier	2	2	0
28. **Marine Barometer** of simple construction, quite trustworthy, ivory scales and gimbals, sliding vernier and attached Thermometer, in solid mahogany . . .	2	0	0
29. **Marine Barometer,** carved top, attached Thermometer, single vernier, capillary tube, to prevent ingress of air during violent oscillations of a storm . . .	2	15	0
30. **Marine Barometer,** same as preceding, in carved frame inlaid with pearl	3	12	6

MARINE BAROMETERS.

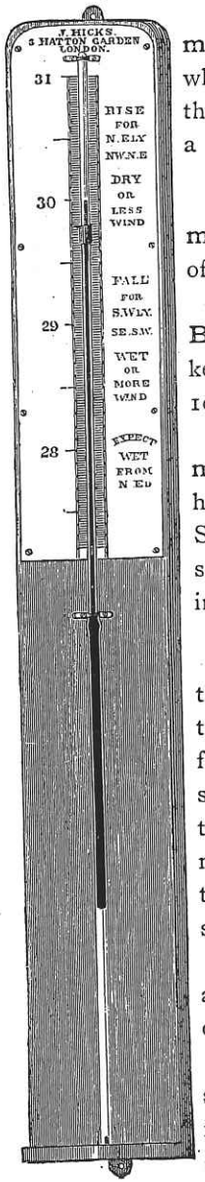


15. 16. 17. 18.

SCALE ABOUT $\frac{1}{6}$.

	£	s.	d.
31. **Solid Rosewood Marine Barometer,** brass arm gimbals and attached Thermometer complete, ivory scale (compensated), reads by vernier to 1-500th inch (Fig. 18)	2	0	0
32. **Solid Rosewood Combined Marine Barometer,** substantially made, is furnished with stout brass arm and gimbals, double vernier, for temporarily recording the difference between two readings. It has a Sympiesometer attached, which, with its Thermometer, affords the means of making accurate and *comparative* observations (Fig. 15)	5	0	0
33. **Solid Rosewood Combined Marine Barometer,** smaller size than Fig. 15	3	17	6

HICKS' OPEN SCALE BAROMETERS.



19.
SCALE ABOUT 1-7TH.



20.
ABOUT 1-7TH

34. **Hicks' Patent Open Scale Barometer.**—This instrument yields readings in which a rise or fall of one inch of mercury on the ordinary Barometer scale is extended over a space of five inches to one inch (Fig. 19). £1 8 6

35. **Hicks' Patent Open Scale Barometer,** with a range of 10 inches to one inch of ordinary Barometer scale. £2 0 0

36. **Hicks' Patent Standard Open Scale Barometer,** on mahogany board with brackets, reading with verniers top and bottom to 1000th of an inch (Fig. 20). £6 0 0

37. **Hicks' Patent Spiral Tube Barometer** (Fig. 10), mounted in metal on mahogany board, with brackets, similar to Standard No. 1. In this instrument the scale is so open as to give 12 inches to one inch on the ordinary Barometer scale. £16 16 0

It will be seen on reference to Fig. 19 that the lower half of the tube is larger in the bore than the upper. When the column falls from the upper tube to the lower, it becomes shorter, and *vice versa*. It will thus be seen that by varying the relation between the diameters of the upper and lower portions of the tube, scales of any range may be constructed.

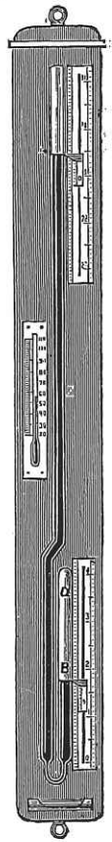
Fig. 19 illustrates an instrument in which a rise or fall of five inches is equivalent to one inch of the ordinary Barometer scale.

Fig. 20 represents an instrument with tube similarly constructed to Fig. 19, but mounted in brass tube divided from the centre upwards and downwards, with verniers to read at each end to the 1000th of an inch, the sum of the two readings giving the exact height of the Barometer at the time of observation. A delicate Thermometer is attached, to enable the usual corrections for temperature to be made.

LONG RANGE AND SYPHON BAROMETERS.

38. * **Howson's Patent Long Range Barometer.**—The bore of the tube in this instrument is not less than one inch, to afford room for a long glass rod of proportionate diameter, which, besides sustaining the glass cistern attached to it, serves also to open the range, by displacing a quantity of mercury far in excess of that which results from a diminution of atmospheric pressure. In constructing the Barometer, the tube is filled with mercury and held with its open end upward, the glass rod with attached cistern being then introduced. On inverting the tube, to fix it in its frame, the rod and cistern do not (as might be anticipated) fall out, but the rod, by its lesser gravity, floats in the mercury, and thus keeps the cistern near the open end of the tube, through which only sufficient mercury escapes to form an ordinary mercurial column. When a fall takes place, the mercury extended increases the weight of the cistern, and the rod being thereby drawn out, multiplies the apparent range; and the reverse takes place on an increase of atmospheric pressure, so that, without a vernier, this Barometer may be read to three places of decimals. £9 9 0

39. * **McNield's Long Range Barometer.**—The principle of this instrument is the same as the preceding, but the arrangement of the parts is reversed, the tube being made to float while the cistern is fixed. The scale is graduated on the tube, and when the mercury falls, as a consequence of decreased pressure, the level in the cistern rises, causing the floating tube to rise also, and thus produce an additional descent in the column. An equal and proportionate extension of the reading takes place in the opposite direction, when an increase of pressure takes place —the mercury leaving the cistern causes the tube to fall, and induces more mercury to enter the tube. £12 12 0



21.
ABOUT 1-12TH.

40. † **Gay Lussac's Syphon Barometer,** engine divided and figured on the tube, for laboratory use, with Thermometer. £2 5 0

41. † **Gay Lussac's Standard Syphon Tube Barometer,** of larger size, with metal scales and verniers, mounted on mahogany board, with attached Thermometer (Fig. 21). £4 12 6

* It will be apparent that these Barometers require no adjustment for "neutral point," being self-adjusting and quite unaffected by differences of level in the cistern.

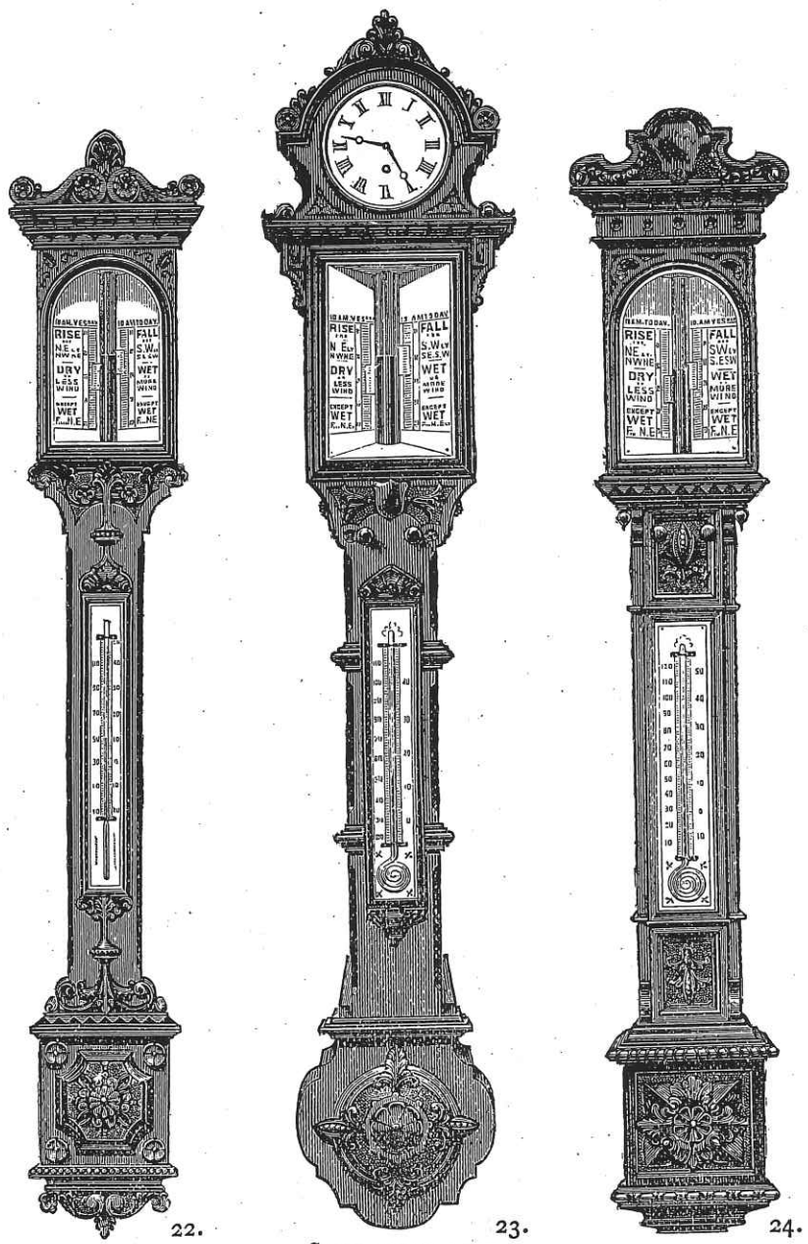
† These Barometers require no correction for capillarity or capacity, each surface of mercury being equally depressed by capillary attraction; and the quantity of mercury falling from the long limb occupies the same space in the short limb. The usual correction for temperature must, however, be applied.

PEDIMENT BAROMETERS.

	£	s.	d.
42. **Full size Barometer** in elaborately carved oak frame, surmounted by superior eight-day timepiece with 5-in. dial, regulated from the front. The scales are in enamel, FITZROY words, double vernier with rack and pinion adjustments and portable screw. An extra-sensitive spiral Thermometer with FAHRENHEIT and Centigrade scales is attached, and the instrument will be found specially suitable for the library or entrance hall (Fig. 23)	14	14	0
43. **Highly Carved Oak Frame Barometer,** tube ¾-in. bore, ensuring freedom from error of capillarity, for hall or large buildings, enamelled or ivory scales, FITZROY words and double vernier with rack and pinion adjustments, attached Thermometer, thick plate glass fronts .	12	12	0
44. ***Torricelli-Drebel Barometer** (Registered.)—The frame of this instrument is elaborately carved in the Italian Renaissance style, and is surmounted by a carved head of Torricelli, under which are the words in antique letter, "Torricelli invt. 1643." A highly sensitive spiral Thermometer is attached, with FAHRENHEIT and CELSIUS Scales, and surmounted by a carved head of Drebel, the inventor of the Thermometer, with words also in antique letter, "Drebel invt. 1620," under the head. In addition to being a most handsome piece of furniture for the hall or library, the instrument thus assumes an educational character. It has a bold tube supported by enamel scales, having FITZROY words and double vernier of enamelled glass, with rack and pinion adjustments and portable screw (Fig. 26)	10	0	0
45. **Large richly Carved Oak Barometer,** enamel or ivory scales, FITZROY words, double vernier with rack and pinion adjustments, large spiral attached Thermometer, and portable screw for convenience and safety in moving the instrument (Fig. 24)	10	0	0
46. **Large Carved Solid Oak Barometer,** double vernier with metal pointers, rack and pinion adjustments, enamelled or ivory scales, attached Thermometer and floating gauge (Fig. 25)	7	10	0
47. **Best Carved Solid Oak Barometer,** elaborate design, scroll and shell top, enamel or ivory scales, FITZROY words—or, "Fair," "Change" and "Rain"—double vernier with rack and pinion adjustments and attached Thermometer (Fig. 22)	7	0	0

* The design of this instrument was suggested by Mr. J. MARTIN.

The above and following Barometers, where enamelled glass scales are used, may be had with red or black letters as desired.



22. 23. 24.

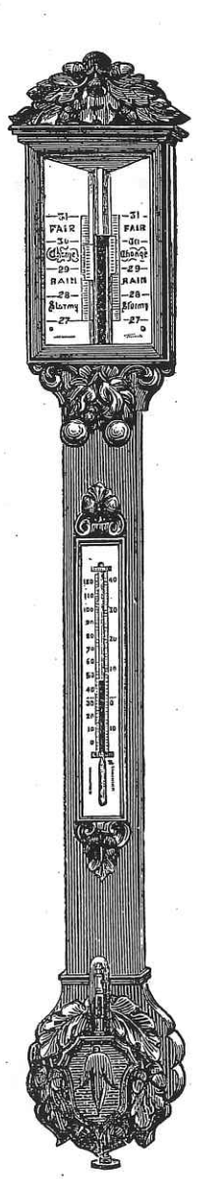
SCALE ABOUT 1-7TH.

PEDIMENT BAROMETERS.

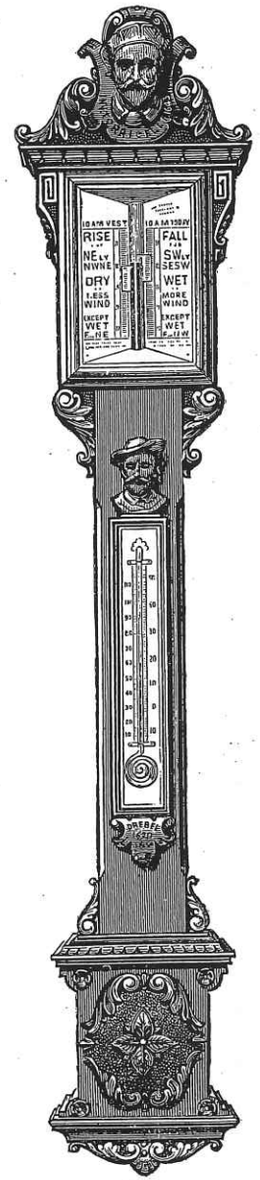
	£	s.	d.
(22) Shell and Scroll Barometer	7	0	0
(23) Clock Barometer	14	14	0
(24) Shield Top Barometer	10	0	0

PEDIMENT BAROMETERS.

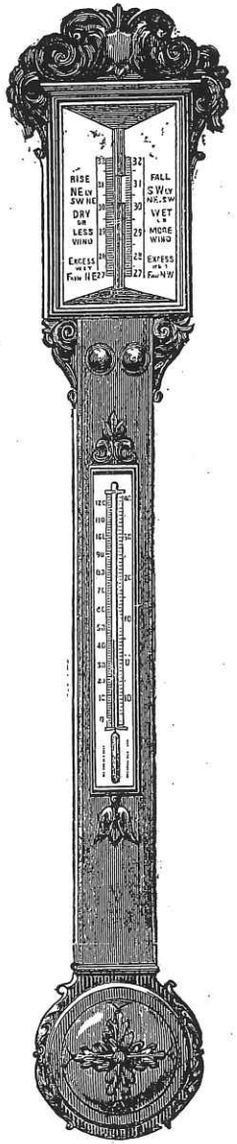
	£	s.	d.
48. **Best Carved Solid Oak Barometer,** enamel or ivory scales, FITZROY words—or, "Fair," Change" and "Rain"—double vernier with metal pointers, rack and pinion adjustments and attached Thermometer (Fig. 28).	6	10	0
49. **Best Carved Solid Oak Barometer,** enamel or ivory scales, FITZROY words—or, "Fair," "Change" and "Rain"—double vernier with metal pointers, rack and pinion adjustments and attached Thermometer (Fig. 29).	6	10	0
50. **Carved Solid Oak Barometer,** enamel or ivory scales, double vernier with metal pointers, rack and pinion adjustments and attached Thermometer (Fig. 30) . . .	6	6	0
51. **Best Carved Solid Oak Barometer,** enamelled or ivory scales, double vernier with metal pointers, rack and pinion adjustments and attached Thermometer .	6	6	0
52. **Best Carved Solid Oak Barometer,** carved cross, enamelled or ivory scales, double vernier with metal pointers, rack and pinion adjustments and attached Thermometer (Fig. 27)	6	6	0
53. **Best Carved Solid Oak Barometer,** Gothic design, enamelled or ivory scales, double vernier with metal pointers, rack and pinion adjustments, attached Thermometer, plate glass fronts (Fig. 31)	6	0	0
54. **Best Carved Solid Oak Barometer,** castellated top, enamelled or ivory scales, double vernier with metal pointers, rack and pinion adjustments, attached Thermometer, plate glass fronts (Fig. 33)	6	0	0
55. **Carved Solid Oak Barometer,** same as 54, but smaller size	5	5	0
56. **Carved Solid Oak Sea Coast Barometer,** round top, enamel or porcelain scales, double vernier, metal pointers, rack and pinion adjustments, attached Thermometer (32)	4	15	0
57. **Sea Coast Barometer,** plain round top, same as above (Fig. 34)	4	10	0
58. **Sea Coast, or Fishery Barometer,** in solid oak with brass fastenings, porcelain scale with lettering burnt in, double vernier, reading to 100th inch, extra large attached Thermometer, engine divided on stem, and figured on scale, which is very open, plate glass door, to admit of removal of moisture from scale and tube (Fig. 35)	5	0	0
59. **Carved Solid Oak Barometer** for Sea Coast, square top, enamelled or porcelain scales, double vernier with rack and pinion adjustments, attached Thermometer and plate glass fronts	4	10	0
60. **Solid Oak Barometer,** plain frame as above (Fig. 36)	4	4	0
61. **Carved Solid Oak Barometer,** enamel or ivory scales, double vernier with rack and pinion adjustments and attached Thermometer (Fig. 42)	4	10	0
62. **Solid Oak Barometer** for Sea Coast, square top, enamelled or porcelain scales, single vernier with rack and pinion adjustments, and attached Thermometer and plate glass fronts (Fig. 37)	3	10	0



25.



26.

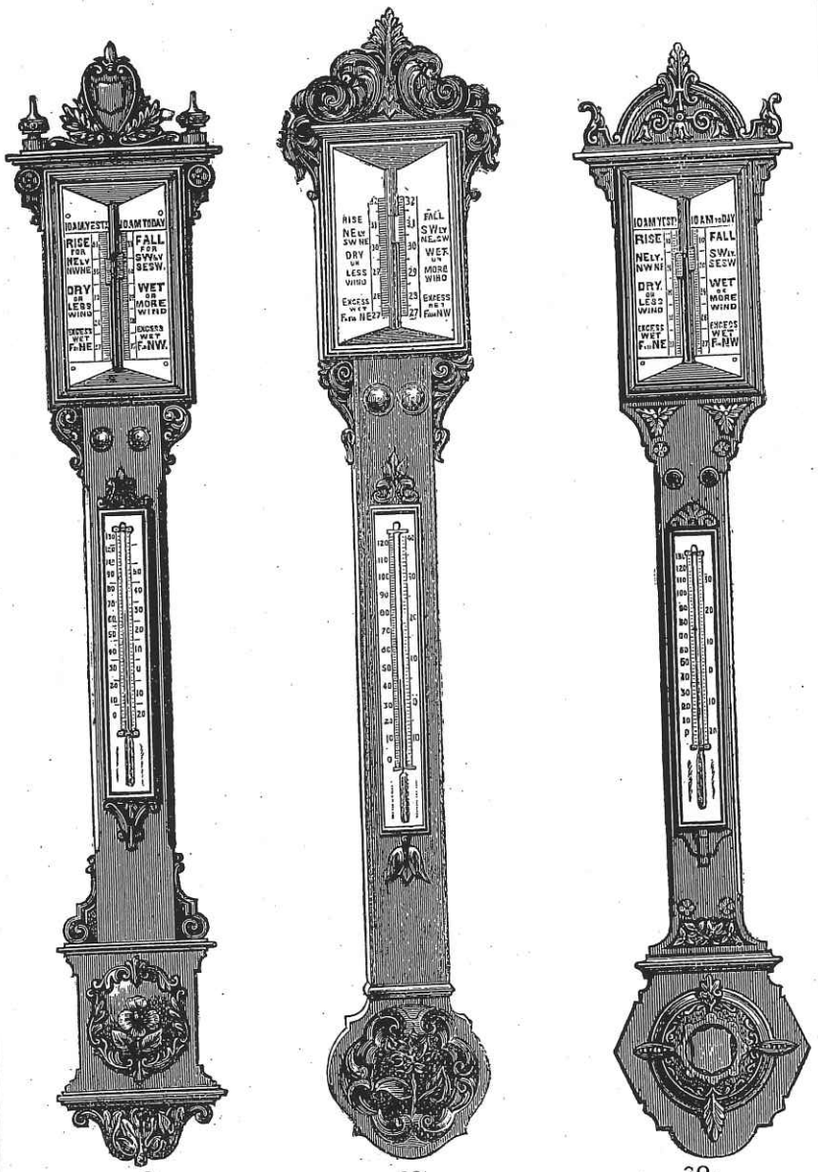


27.

SCALE ABOUT 1-7TH.

PEDIMENT BAROMETERS.

	£	s.	d.
(25) **Floating Gauge Barometer**	7	10	0
(26) **Torricelli-Drebel Barometer**	10	0	0
(27) **Carved Cross Barometer**	6	6	0

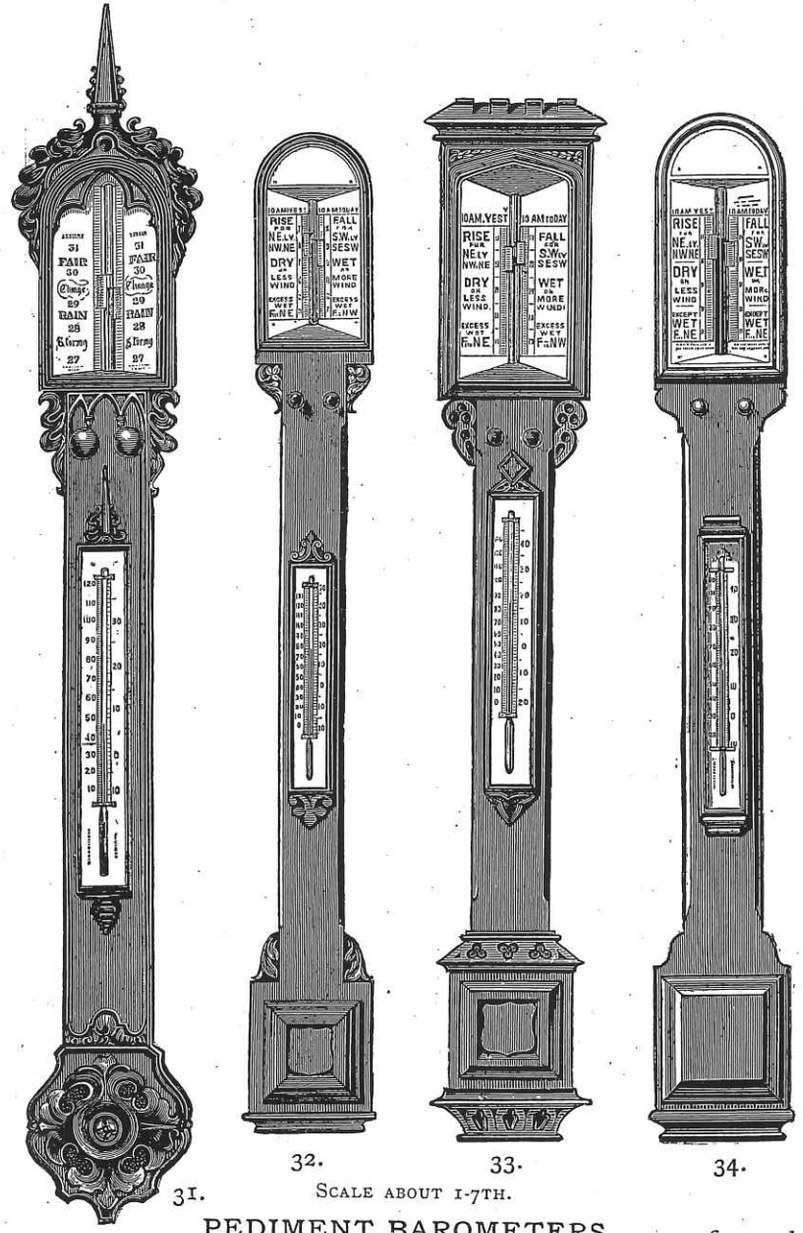


28. 29. 30.

SCALE ABOUT 1-7TH.

PEDIMENT BAROMETERS.

	£	s.	d.
(28) Shield and Point Barometer	6	10	0
(29) Pointed Top Barometer	6	10	0
(30) Solid Oak Barometer	6	6	0

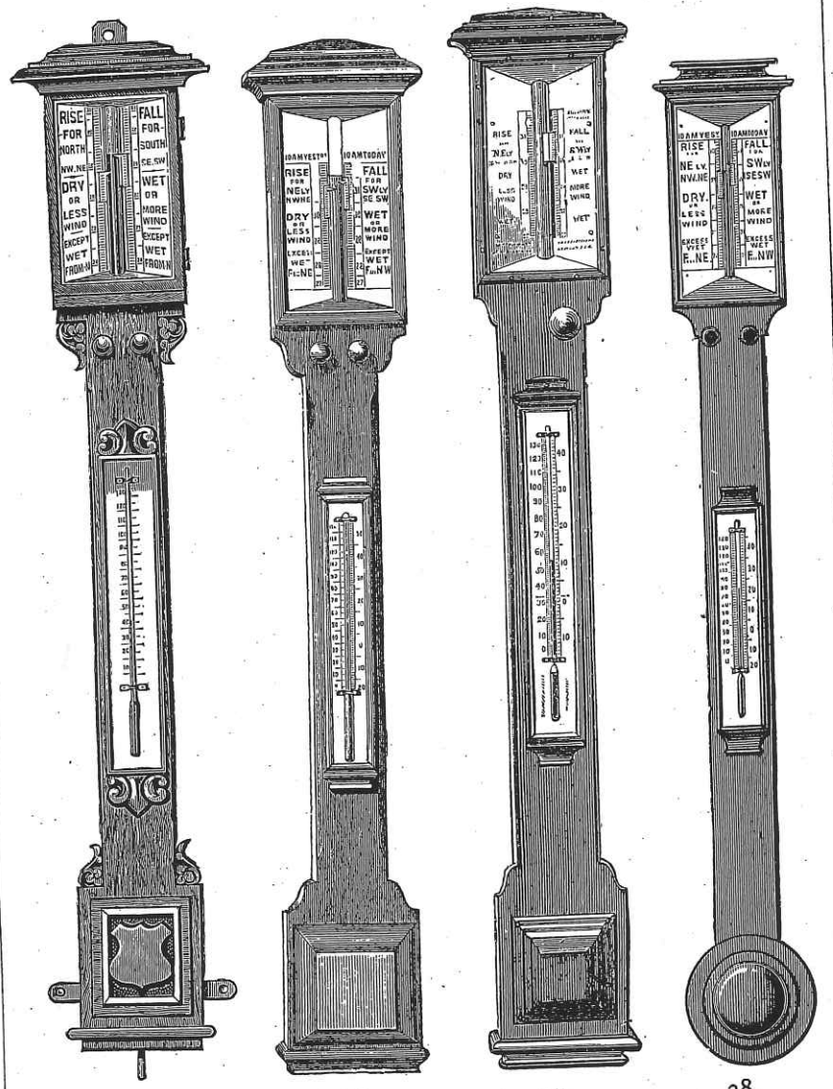


31. 32. 33. 34.

SCALE ABOUT 1-7TH.

PEDIMENT BAROMETERS.

	£	s.	d.
(31) Ecclesiastical Barometer	6	0	0
(32) Round Top Sea Coast Barometer (carved)	4	15	0
(33) Castellated Top Barometer	6	0	0
(34) Round Top Sea Coast Barometer	4	10	0

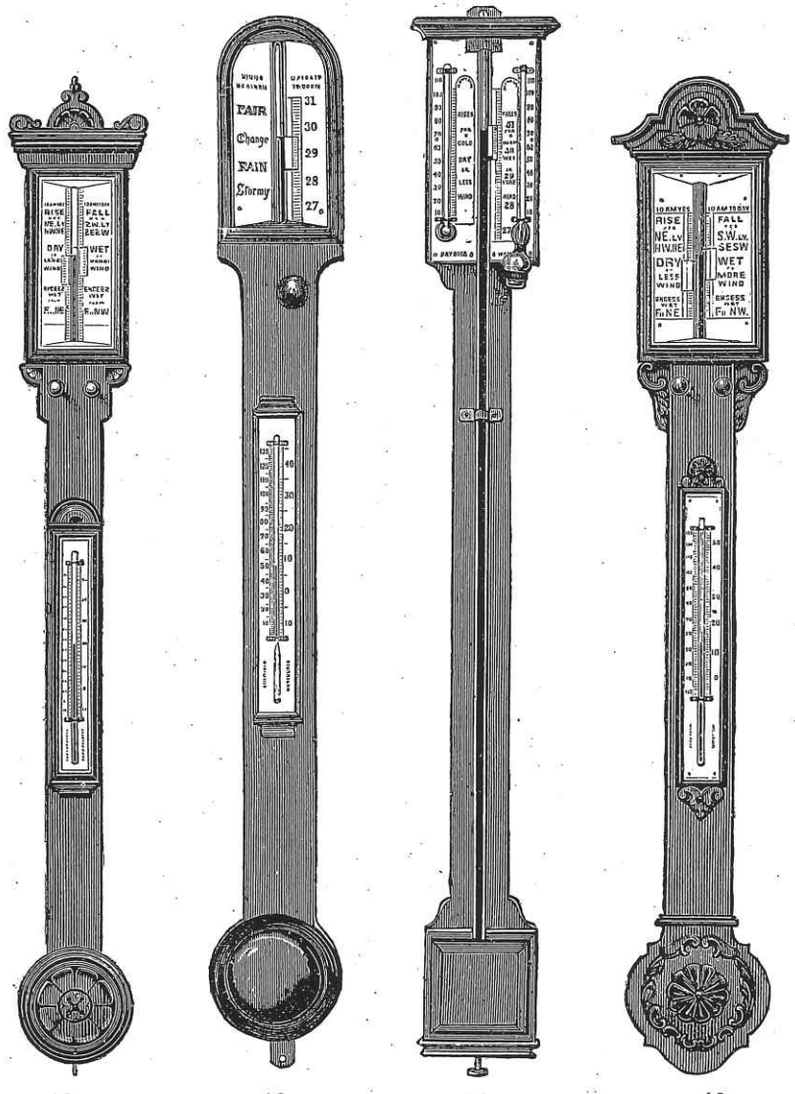


35. 36. 37. 38.

SCALE ABOUT 1-7TH.

PEDIMENT BAROMETERS.

	£	s.	d.
(35) Sea Coast, or Fishery Barometer . . .	5	0	0
(36) Sea Coast Square Top Barometer . . .	4	4	0
(37) Sea Coast Square Top Barometer, single rack .	3	10	0
(38) Sea Coast Square Top Barometer (small), double rack	2	10	0



39. 40. 41. 42.

SCALE ABOUT 1-7TH.

PEDIMENT BAROMETERS.

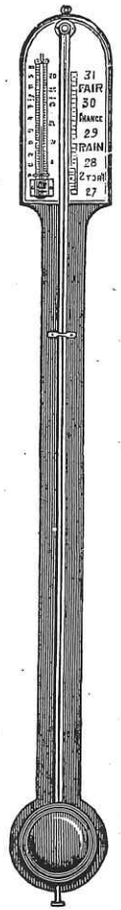
	£	s.	d.
(39) Carved Barometer (small size)	3	3	0
(40) Dome Top Walnut Barometer	3	0	0
(41) Farmer's Barometer	1	15	0
(42) Passerini Pattern Barometer	4	10	0

PEDIMENT BAROMETERS.

	£	s.	d.
63. **Small Carved Oak Barometer**, enamelled scales, double vernier, with rack and pinion adjustments and attached Thermometer (Fig. 39)	3	3	0
64. **Small Carved Oak Barometer**, same as preceding, with single rack	3	0	0
65. **Plain Walnut Frame Barometer**, dome top, enamel scales, double vernier, with rack and pinion adjustments and attached Thermometer	3	3	0
66. **Plain Walnut Frame Barometer**, dome top, &c., same as preceding, with single vernier (Fig. 40)	3	0	0
67. **Solid Oak Barometer**, for Sea Coast, small size, square top, ivory scales, double vernier, with rack and pinion adjustments and attached Thermometer (Fig. 38)	2	10	0
68. **Solid Oak Barometer**, small size as above, single vernier, with rack and pinion adjustments	2	5	0
69. **Small Round Top Barometer**, in oak or rosewood, ivory scales, single vernier, with rack and pinion adjustments and attached Thermometer	1	10	0
70. **Farmer's Barometer**, on solid oak frame, ivory or enamel scales, sliding vernier, wet and dry bulb Thermometers, indicating temperature and moisture (Fig. 41)	1	15	0
71. **Farmer's Barometer**, in carved oak frame, same as preceding	1	15	0
71* **Farmer's Barometer**, small carved ivory scales	1	7	6
72. **Solid Oak Barometer**, for Sea Coast, square top, middle size, ivory or enamel scales, double vernier, rack and pinion adjustments and attached Thermometer	3	3	0
73. **Solid Oak Barometer**, for Sea Coast, square top, same size as preceding, single vernier with rack and pinion adjustments	3	0	0
74. **Carved Walnut Frame Barometer**, ivory or enamel scales, double vernier with rack and pinion adjustments, circular flowered cap	3	0	0
75. **Carved Walnut Frame Barometer**, same as preceding, single vernier with rack and pinion adjustments	2	15	0
76. **Carved Oak Barometer**, enamel or ivory scales, double vernier, rack and pinion adjustments, attached Thermometer (like Fig. 30), extra carving to body	6	10	0
77. **Solid Oak Barometer**, neatly carved in leaf and flower design, enamel or ivory scales, double vernier with rack and pinion adjustments	6	6	0
78. ***The "Exchange," or "Reading Room" Barometer**, in massive solid oak frame elaborately carved, with pillars at side, in Ionic design, very bold tube and broad enamelled glass scales, FITZROY words—or "Fair," "Change" and "Rain"—double vernier with metal pointers and rack and pinion adjustments, spiral Thermometer with very legible FAHRENHEIT and Centigrade scales attached, and thick plate glass fronts	14	14	0

* This Barometer has an imposing appearance, and is well adapted for Public Institutions.

PEDIMENT BAROMETERS.



43.
SCALE ABOUT 1-7TH.

79. **The Model Barometer**, enamel scale, sliding vernier, tube visible throughout, with portable screw. £0 18 6

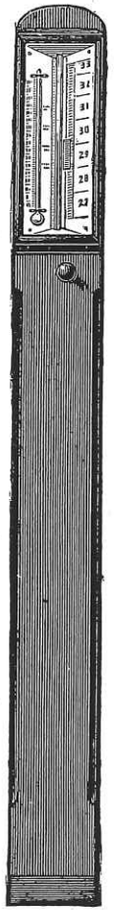
80. **The Model Barometer**, enamel scale, &c., as preceding, with attached Thermometer. £1 1 0

81. **The Model Barometer**, ivory scales, sliding vernier, and Thermometer. £0 18 6

82. **The Model Barometer**, best mounted, bold tube and enamel Thermometer. £1 1 0

83. **The Small Cottage Barometer**, in mahogany frame, ivory scales, sliding metal pointer. £0 13 6

84. **The Small Cottage Barometer**, in mahogany frame, ivory scales and pointer, with Thermometer. £0 15 6



44.
SCALE ABOUT 1-7TH.

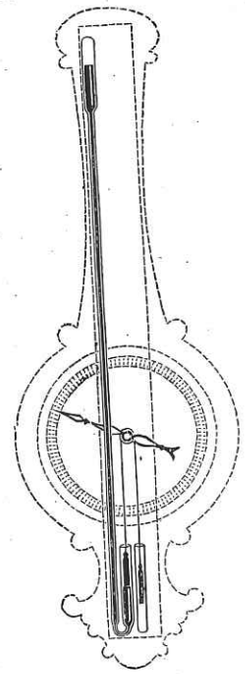
MINERS' BAROMETERS.

Close observation has recently shown that before an explosion in coal mines, there occurs a diminution of atmospheric pressure, and so convinced have the legislature become of the importance of this indication, that an Act of Parliament has been passed with the object of averting the disastrous consequences of explosions, by rendering the use of the Barometer compulsory.

85. **Miners' or Pit Barometer**, compact solid oak frame (screwed), compensated tube, ivory scale reading to 33 inches, attached enamel Thermometer, single vernier with rack and pinion adjustments, strong glass face, framed in bronze metal (Fig. 44). £1 12 0

	£	s.	d.
86. **Miners' or Pit Barometer**, in compact solid oak frame, &c., same as preceding, round top, metal and glass face, scale reading to 33 inches, with portable screw	1	12	0
87. **Miners' or Pit Barometer**, open face, ivory or enamel scales, sliding vernier, attached Thermometer, India-rubber bag over cistern, the brasswork and cistern coated with marine glue, to prevent moisture penetrating, and reading to 34 inches	1	15	0
88. **Miners' or Pit Barometer**, same as preceding, scale reading to 32 inches	1	12	6
89. **Miners' or Pit Barometer**, same as preceding, ordinary cistern, scale reading to 34 inches	1	7	6
90. **Miners' or Pit Aneroid Barometer**, for description see page 52, No. 199	3	3	0

WHEEL BAROMETERS.

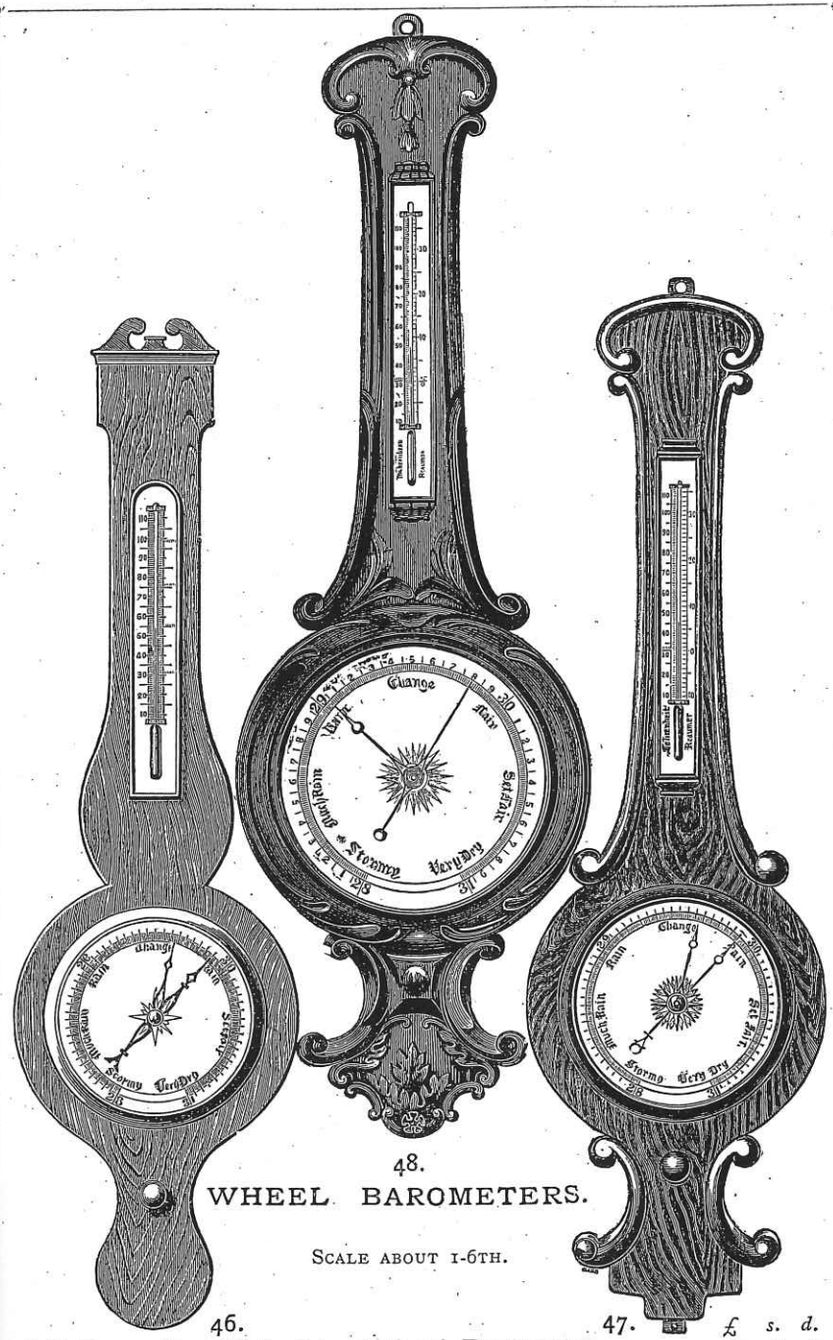


45.
SCALE ABOUT 1-8TH.

This is an instrument in which the varying height of a column of mercury is shown by the movement of a needle on a divided circular dial. This is accomplished by adopting the syphon for the Barometer tube, which is concealed behind the dial and frame. An iron or glass float sustained by the mercury in the open branch is suspended by a counterbalance a *little* lighter than itself. The axis of the pulley has the needle attached to it and consequently moves the needle with the rise and fall of the mercury. It is obvious therefore that if the atmospheric pressure increases the float falls and the needle turns to the right, and if it diminishes the needle turns in the opposite direction. The divisions on the scale represent inches, tenths, and hundreths in the rise and fall of a column of mercury, and these can be read with great facility, as one inch occupies the space of six or more on this very open scale, according to size of dial. The wording is of course arbitrary, and indicates the probable weather that may be expected.

Important improvements have recently been effected in this form of Household Barometer, so that they may be recommended as good weather indicators where facility of reading is a desideratum. They are all furnished with delicately balanced indices which respond to the slightest variations of atmospheric pressure, and a great variety of new patterns of frames has been introduced, of which the following is a description:—

	£	s.	d.
91. **Wheel Barometer**, 8-in. silvered metal dial, 10-in. attached spirit Thermometer (Fig. 46)	1	1	0
92. **Wheel Barometer**, 8-in. silvered metal dial, convex mirror, spirit level, oat-beard hygrometer, and attached spirit Thermometer	1	1	0
93. **Wheel Barometer**, 8-in. silvered metal dial, "Dotti" or scroll pattern, 10-in. attached plain Thermometer, without beading	1	10	0
94. **Wheel Barometer**, 8-in. silvered dial, "Dotti" pattern, beaded scroll, 10-in. attached plain Thermometer (Fig. 47)	2	0	0
95. **Wheel Barometer**, same as preceding, but plate glass front	2	10	0
96. **Wheel Barometer**, 8-in. silvered dial, "Dotti" pattern, slightly carved scroll work, 10-in. enamel attached Thermometer	2	10	0
97. **Wheel Barometer**, 8-in. silvered dial, chastely carved, plate glass front, 10-in. enamel attached Thermometer	3	3	0
98. **Wheel Barometer**, 10-in. silvered dial, convex mirror, spirit level, oat-beard hygrometer, and attached spirit Thermometer	2	0	0



48.

WHEEL BAROMETERS.

SCALE ABOUT 1-6TH.

46. 47.

	£	s.	d.
(46) **Long Box Plain 8-in. Wheel Barometer**	1	1	0
(47) **Beaded "Dotti" 8-in. Wheel Barometer**	2	0	0
(48) **Beaded "Dotti" 10-in. Carved Wheel Barometer**	4	10	0

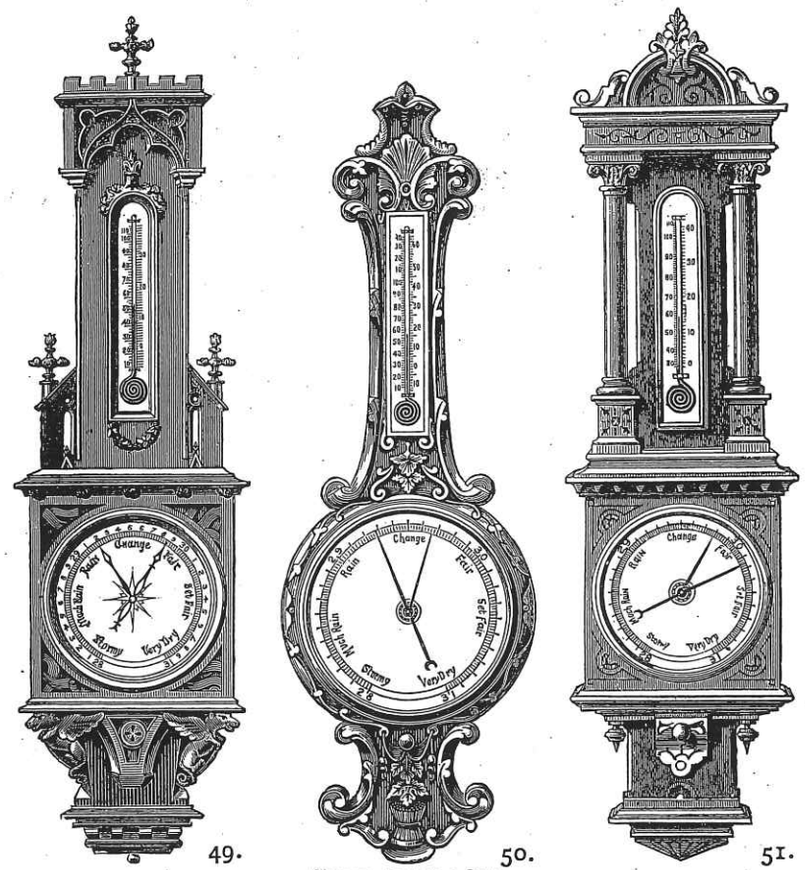
WHEEL BAROMETERS.

	£	s.	d.
99. **Wheel Barometer,** 10-in. silvered dial, "Dotti" pattern, no beading, attached plain Thermometer	2	0	0
100. **Wheel Barometer,** 10-in. silvered dial, "Dotti" pattern, beaded scroll, attached plain Thermometer	2	15	0
101. **Wheel Barometer,** 10-in. silvered dial, same as preceding, but plate glass front	3	3	0
102. **Wheel Barometer,** 10-in. silvered dial, best ring bevelled plate glass fronts, Thermometer, &c., as preceding	3	5	0
103. **Wheel Barometer,** 10-in. silvered dial, "Dotti" pattern, slightly curved scroll work, 10-in. enamel attached Thermometer	3	10	0
104. **Wheel Barometer,** 10-in. silvered dial, elaborately carved in any wood, 10-in. Thermometer (Fig. 48)	4	10	0
105. **Wheel Barometer,** 10-in. porcelain dial, handsomely engraved ornamental centre, "Dotti" pattern, beaded scroll, best ring bevelled plate glass fronts, and 10-in. enamel attached Thermometer on opal scale, FAHR. and Cent. scales	3	15	0
106. **Wheel Barometer,** 10-in. silvered dial, handsomely carved solid oak frame, best ring bevelled plate glass front, enamel attached Thermometer, FAHR. and Cent. scales, acorn and leaf pattern	5	0	0
107. **Wheel Barometer,** 10-in. silvered or porcelain dial, handsomely carved in oak, circular centre, enamel tube Thermometer, FAHR. and Cent. scales	4	10	0
108. **Wheel Barometer,** 12-in. silvered dial, oat-beard hygrometer, convex mirror, spirit level and attached Thermometer	2	10	0
109. **Wheel Barometer,** 12-in. silvered dial, attached Thermometer	2	10	0
110. **Wheel Barometer,** 12-in. silvered dial, "Dotti" or scroll pattern, attached enamel Thermometer	3	10	0
111. **Wheel Barometer,** 12-in. silvered dial, "Dotti" pattern, beaded scroll, carved enamel attached Thermometer	3	15	0
112. **Wheel Barometer,** 12-in. silvered dial, "Dotti" pattern, carved scroll work, enamel Thermometer	5	0	0
113. **Wheel Barometer,** 8-in. silvered dial, Mediæval design, square centre, elegantly carved in solid oak, enamel tube Thermometer, FAHR. and Cent. scales	4	0	0
114. **Wheel Barometer,** 12-in. silvered dial, in handsomely inlaid mother-o'-pearl frame, attached Thermometer, enamel FAHR. and Cent. scales	4	0	0

These instruments are supplied in rosewood, walnut, mahogany or oak frames.

Steel or Glass Stopcocks, to render Barometers portable, 4/6 extra.

Wheel Barometers intended for exportation should be expressly described as such, in order that the necessary precautions against injury may be adopted in packing.

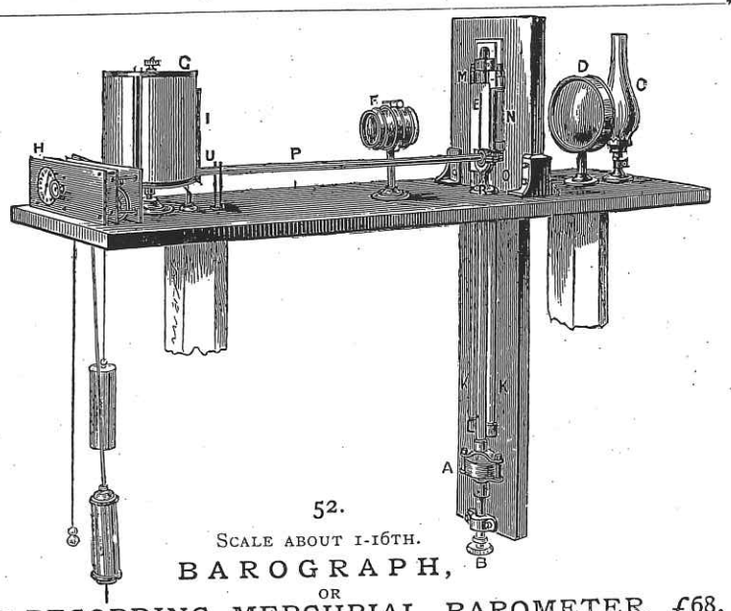


49. 50. 51.

SCALE ABOUT 1-8TH.

CARVED WHEEL BAROMETERS.

	£	s.	d.
115. **Wheel Barometer,** 10-in. silvered or porcelain dial, Gothic design, castellated top, richly ornate, square centre carved in solid oak, spiral attached Thermometer, having enamel tube, Fahr. and Cent. scales (Fig. 49)	11	11	0
116. **Wheel Barometer,** same as preceding, 8-in. dial	9	9	0
117. **Wheel Barometer,** 10-in. silvered or porcelain dial, richly carved solid oak in elaborate floral design, circular centre, enamel tube, spiral Thermometer, Fahr. and Cent. scales (Fig. 50)	6	6	0
118. **Wheel Barometer,** same as preceding, 8-in. dial	5	0	0
119. **Wheel Barometer,** 8-in. silvered dial, richly carved Ionic pillars, square centre in solid oak, enamel spiral attached Thermometer, Fahr. and Cent. scales (Fig. 51)	9	9	0
120. **Wheel Barometer,** same as preceding, 10-in. silvered or porcelain dial	11	11	0
121. **Wheel Barometer,** 10-in. silvered or porcelain dial, Mediæval design, square centre, elegantly carved in solid oak, enamel tube Thermometer, Fahr. and Cent. scales	5	0	0



52.

SCALE ABOUT 1-16TH.

BAROGRAPH,
OR
SELF-RECORDING MERCURIAL BAROMETER, £68.

As adopted by the Meteorological Committee of the Royal Society.

122. This instrument is simpler in its arrangement than the Thermograph, but resembles it in recording photographically, not temperature, but the changes in the height of the Barometer. A clock revolves a cylinder, bearing photographic paper, once in 48 hours.

A double combination of achromatic lenses brings to a focus rays passing through a slit placed in front of the mercurial column, behind which is a strong gas-light or paraffin lamp, the rays of which are condensed upon the slit by two plano-convex lenses (see page 7.)

SYMPIESOMETERS.

This instrument is now used chiefly in conjunction with the Mercurial and Aneroid Barometers, for purposes of comparison. Its indications result partly from the pressure, and partly from the temperature of the atmosphere; it would, therefore, be more correctly named a Thermo-Barometer.

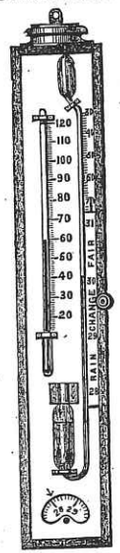
In using it, note first the temperature of the attached Thermometer, then adjust the metal pointer of the pressure scale to the same degree as the Thermometer at side; the height at which the coloured fluid then stands, shows on the sliding scale the atmospheric pressure in inches and tenths of the Barometer scale.

123. **Sympiesometer,** in rosewood or mahogany frame, rack work motion, plate glass front registering index (Fig. 53). £3 0 0

124. **Sympiesometer** as above, sliding motion £2 10 0

125. **Sympiesometer,** portable, for taking altitudes, in sling leather case (10,000 feet). £3 0 0

126. **Sympiesometer,** same as preceding, for altitudes to 15,000 feet, for the pocket. £4 10 0



53.

SCALE ABOUT 1-8TH.

STORM GLASS,
OR
CHEMICAL WEATHER GLASS.

This instrument has been known for more than a hundred years, and though the name of the inventor is unknown, tradition attributes the honour to an Italian sailor. It is simply a glass bottle, 10 inches long, containing a mixture of camphor, nitre, sal-ammoniac, alcohol and water. It has latterly fallen somewhat into disrepute from want of due care being exercised in the preparation of the solution; but when properly prepared it will be "found useful for aiding, with the Barometer and Thermometer, in forecasting the weather."

The late Admiral Fitzroy, in speaking of this instrument, says: "Temperature affects the mixture much;" and, in order to facilitate observations under this head, J. J. HICKS has recently designed and registered an arrangement in which the stem of a Thermometer is immersed in the fluid, as shown at Fig. 56, thus imparting a higher value to the indications of the instrument. The following remarks by the Admiral will show that he attached a certain amount of importance to the instrument, as confirmatory of the indications of the Barometer, &c.:—

"Since 1825, we have generally had some of these glasses, as curiosities rather than otherwise; for nothing certain could be made of their variations until lately, when it was fairly demonstrated that if fixed undisturbed in free air, not exposed to radiation, fire, or sun, but in the ordinary light of a well-ventilated room, or, *preferably*, in the outer air, the chemical mixture in a so-called storm glass varies in character with the *direction* of the wind—not its force, *specially* (though it *may* so vary in *appearance*, only from another cause—*electrical tension*).

"As the atmospheric current veers toward, comes from, or is only *approaching* from the polar direction, this chemical mixture—if closely, even microscopically watched—is found to grow like *fir, yew*, fern leaves, or hoar-frost—or like crystallizations.

"As the wind, or great body of air, tends more from the *opposite* quarter, the lines or spikes—all regular, hard, or crisp features—gradually diminish till they vanish.

"Before, and in a continued southerly wind, the mixture sinks slowly downward in the vial till it becomes shapeless, like melting white sugar.

"Before, or during the continuance of a northerly wind (polar current), the crystallizations are beautiful (if the mixture is correct, the glass a *fixture*, and duly *placed*); but the least motion of the liquid disturbs them.

"When the main currents meet, and turn *toward the west*, making *easterly* winds, stars are more or less numerous, and the liquid dull, or less clear. When, and while they *combine by the west*, making westerly winds, the liquid is clear, and the crystallization well-defined, without loose stars.

"While *any hard* or *crisp* features are visible below, above, or at the top of the liquid (where they form for polar winds), there is *plus* electricity in the air; a *mixture* of polar current co-existing *in that locality* with the opposite, or southerly.

"When nothing but soft, melting, sugary substance is seen, the atmospheric current (feeble or strong as it may be) is southerly with *minus* electricity, unmixed with, and *uninfluenced* by, the contrary wind.

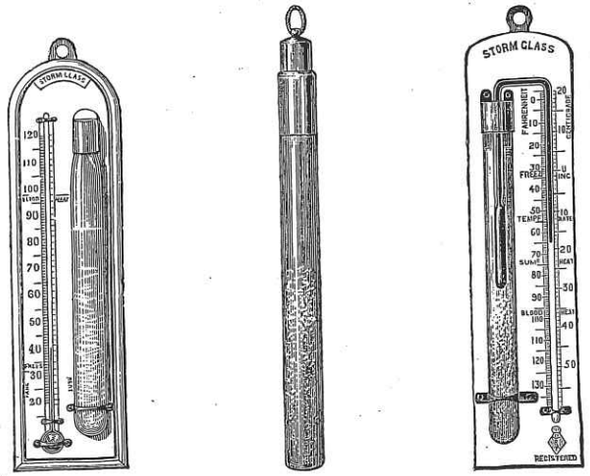
"Repeated trials with a delicate galvanometer, applied to measure electric tension in the air, have proved these facts, which are now found useful for aiding, with the barometer and thermometer, in forecasting weather.

"Temperature affects the mixture much, but not solely; as many comparisons of winter with summer changes of temperature have fully proved.

"A confused appearance of the mixture, with flaky spots, or stars, in motion, and less clearness of the liquid, indicates south-easterly wind, probably strong to a gale.

"Clearness of the liquid, with more or less perfect crystallizations, accompanies a combination, or a contest, of the main currents, by the *west*, and very remarkable these differences are,—the results of these air currents acting on each other *from* eastward, or from an entirely opposite direction, the *west*.

"The glass should be wiped clean now and then; and once or twice a year the mixture should be disturbed, by inverting and gently shaking the glass vial."



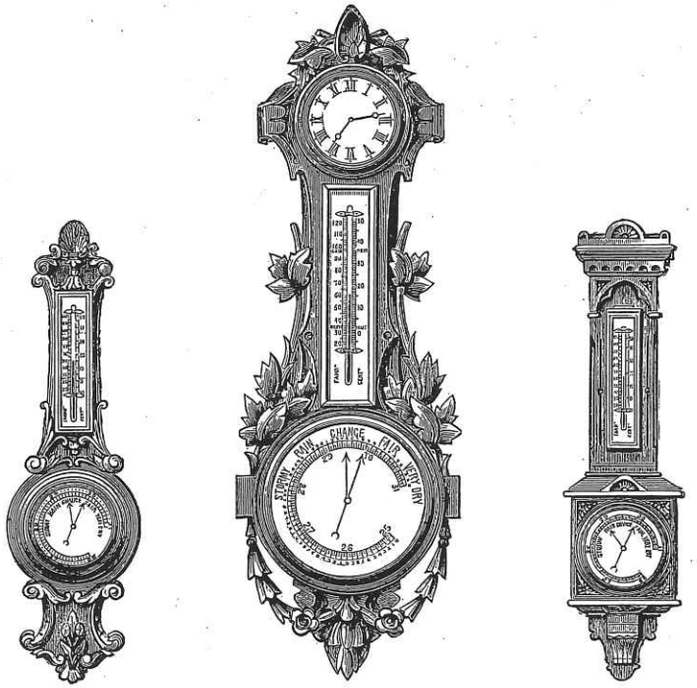
54. 55. 56.

SCALE ABOUT 1-5TH.

STORM GLASSES.

	£	s.	d.
127. **Storm Bottle** (10-in.), 1-in. diameter, brass cap (Fig. 55)	0	3	6
128. **Storm Bottle** (12-in.), 1⅛-in. diameter, brass cap (Fig. 55)	0	4	6
129. **Storm Glass** (8-in.), square top, boxwood scale, per doz.	0	10	6
130. **Storm Glass** (8-in.), square top, boxwood scale, with plain Thermometer per doz.	1	10	0
131. **Storm Glass** (9-in.), eliptic top, boxwood scale, enamel tube Thermometer, FAHRENHEIT scale per doz.	2	5	0
132. **Storm Glass** (10-in.), round top, boxwood scale, enamel tube Thermometer, FAHRENHEIT scale per doz.	3	0	0
133. **Storm Glass** (10-in.), round top, boxwood scale, enamel tube Thermometer, FAHR. and Cent. scales doz.	3	5	0
134. **Storm Glass** (12-in.), round top, boxwood scale, enamel tube Thermometer, FAHRENHEIT scale . each	0	6	6
135. **Storm Glass** (12-in.), round top, boxwood scale, enamel tube Thermometer, FAHR. and Cent. scales each	0	7	6
136. **Hicks' New Registered Storm Glass** (8-in.), having the bulb of the Thermometer immersed in the fluid, boxwood scale, enamel tube Thermometer . each	0	7	6
137. **Hicks' New Registered Storm Glass** (10-in.) ,,	0	9	6
138. **Hicks' New Registered Storm Glass** (12-in.) ,,	0	12	6
139. **Storm Glass**, on best 12-in. porcelain scale, with attached Thermometer, and FAHRENHEIT and Centigrade scales each	0	12	6
140. **Storm Glass**, on best 12-in. porcelain scale, with attached Thermometer, single scale . . each	0	10	6

Printed directions with each instrument.



57. 58. 59.

SCALE ABOUT 1-10TH. SCALE ABOUT 1-7TH. SCALE ABOUT 1-10TH.

ANEROID BAROMETERS.

This convenient form of Barometer is supplied in all sizes, from 1½ inch to 36 inches diameter, and equally sensitive in all sizes.

As weather indicators, they are remarkable for sensibility, while their portability recommends them to Tourists, for estimating the height of mountains, and to Engineers, for ascertaining the depth of mines. Where portability is a desideratum, and extreme accuracy not indispensable, the Aneroid may be fairly chosen before the most portable mercurial Barometer.

Its compact circular form renders it specially suited for travellers, who, forewarned by its indications, may postpone excursions which might end in disappointment, or *vice versa*.

In writing of this instrument the following high authorities thus express themselves:—

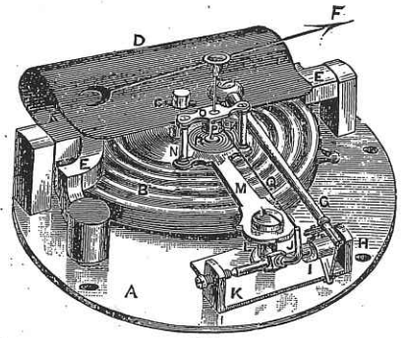
The late Admiral FITZROY, F.R.S.—"*Quick* in showing the variation of atmospheric pressure."

Col. Sir HENRY JAMES, R.E.—"The best form of barometer, *as a weather glass*, that has been made."

JAMES GLAISHER, Esq., F.R.S.—"The Aneroid readings may be *safely depended upon*."

J. H. BELVILLE, Esq., Royal Observatory, Greenwich.—"Its movements are *always consistent*."

Sir LEOPOLD MCCLINTOCK.—"Atmospheric changes are indicated *first* by the Aneroid."



60.

SCALE ABOUT 3-4THS.

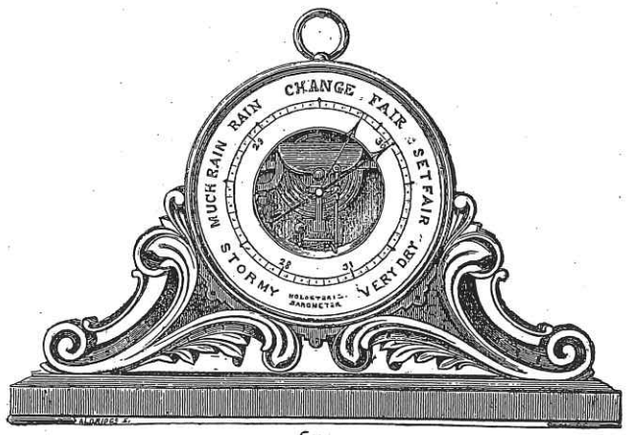
Construction of the Aneroid Barometer.—The Aneroid Barometer, as shown at Fig. 60, consists of the vacuum chamber (B), composed of two discs of corrugated German silver firmly soldered together, forming a box, from which the air is exhausted and to each side of which is attached a brass centre—one with a thread on it to screw the chamber to the base-plate (A), the other plain, with a hole drilled across it to receive a knife-edge (C), which suspends the vacuum chamber from a powerful spring (D), as seen in the drawing. On these principally depends the action of the instrument. The base, or foundation-plate (A), is of iron or brass and circular in form; to this the vacuum chamber is attached, while a strong iron carriage (E), fixed across the chamber, supports the main-spring (D), which, acting in direct opposition to the undulations of the vacuum chamber (B), give rise to the variations of the needle (F) on the dial. To the main-spring (D) is attached to the main lever (C) a compound bar of iron or brass, which compensates for errors arising from changes of temperature. To the end of this arm is attached a small rod of steel to connect it to the regulator, which is furnished at its centre with a vertical arm of brass by which it communicates with the movement.

The "movement" is furnished with a stout base-plate (K), to the centre of which a short brass pillar is screwed, bearing a projecting arm (M), at the end of which are two smaller brass pillars (N), supporting a thin plate of brass (O), and between these and the flat arm works the arbor (P), on which is fixed the index. A piece of fine chain (Q), as used in the works of watches, is attached to and works round the arbor (P) on the rise or fall of the lever, and a fine hair spring of coiled steel (R) keeps the hand in its proper position.

The regulator (I) supports a vertical brass arm (J), to which is attached the fine chain which works round the arbor.

The connection having been made between these various parts, the entire movement is screwed to the iron foundation-plate (A) and connected with the main lever, by means of a fine steel rod at the end, and the communication thus rendered complete between the various parts of the instrument, it is ready for the final adjustment of the dial and hand.

This done, it only remains to graduate the scale, which is effected by placing the instrument under the glass receiver of an air pump with a Standard Mercurial Barometer attached. The air is then exhausted, and, as the mercury falls inch by inch, the Aneroid Scale is pointed off and graduated from 31 inches to any required range.



61.

SCALE ABOUT 1-4TH.

CARD DIAL ANEROID BAROMETERS.

	2nd quality. £ s. d.	1st quality. £ s. d.
141. **Aneroid Barometer**, 5-in. enamel card dial	0 15 6	1 5 0
142. **Aneroid Barometer**, 5-in. enamel card dial	1 5 0	1 10 0
143. **Aneroid Barometer**, 5-in. enamel card dial, with Thermometer	1 5 0	1 10 0
144. **Aneroid Barometer**, 5-in. enamel card dial, open face	1 7 6	2 0 0
145. **Aneroid Barometer**, 5-in. enamel card dial, open face, with Thermometer	1 10 0	2 5 0
146. **Aneroid Barometer**, 5-in. hard enamel dial	1 6 0	1 12 6
147. **Aneroid Barometer**, 5-in. hard enamel dial, with Thermometer	1 7 6	1 15 0
	6-inch.	8-inch.
148. **Aneroid Barometer**, closed card dial, in velvet-lined cloth-covered case	2 2 0	2 15 0
149. **Aneroid Barometer**, closed card dial, in velvet-lined cloth-covered case, with Thermometer	2 10 0	3 0 0
150. **Aneroid Barometer**, open card dial, in velvet-lined cloth-covered case	2 15 0	3 3 0
151. **Aneroid Barometer**, open card dial, in velvet-lined cloth-covered case, with curved Thermometer	2 17 6	3 7 6

SILVERED METAL DIAL ANEROID BAROMETERS.

	2nd quality.	1st quality.
	£ s. d.	£ s. d.
152. **Aneroid Barometer**, 5-in. silvered dial	1 7 6	1 17 6
153. **Aneroid Barometer**, 5-in. silvered dial, with Thermometer	1 10 0	2 2 0
154. **Aneroid Barometer**, 5-in. silvered dial, open face	1 17 6	2 12 6
155. **Aneroid Barometer**, 5-in. silvered dial, open face, with Thermometer	2 2 0	2 15 0
156. **Aneroid Barometer**, 8-in. silvered dial	3 3 0	3 10 0
157. **Aneroid Barometer**, 8-in. silvered dial, with Thermometer	3 7 6	3 15 0



62.

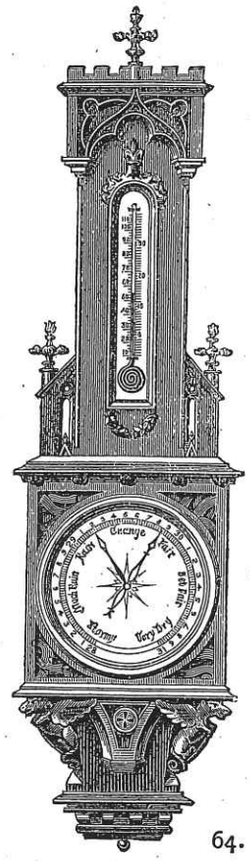


63.

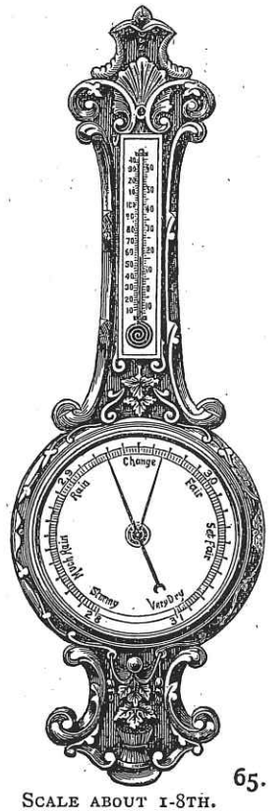
SCALE ABOUT 1-6TH.

DRAWING ROOM ANEROID BAROMETERS.

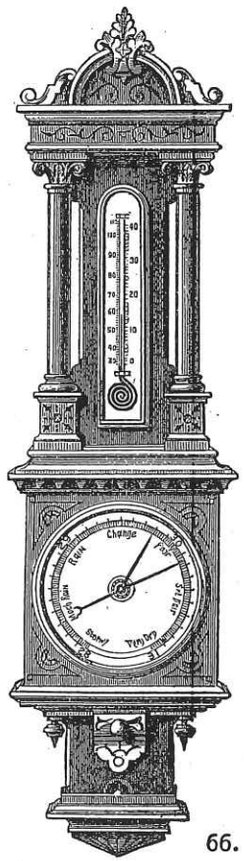
	6-inch. £ s. d.	8-inch. £ s. d.
158. **Aneroid Barometer,** 5-in. metal dial, ordinary range, on bronze "Greyhound" stand (Fig. 62) 3 5 0	4 4 0	4 10 0
159. **Aneroid Barometer,** 5-in. metal dial, ordinary range, with curved Thermometer, on bronze "Sea-horse" stand (Fig. 63) 3 3 0	4 0 0	4 10 0
160. **Aneroid Barometer,** 5-in. open metal dial, ordinary range, two Thermometers, spirit and mercury, on bronze "Benvenuto Cellini" stand 4 4 0	4 15 0	5 5 0
161. **Aneroid Barometer,** closed silvered metal dial, in velvet-lined cloth-covered case . .	2 5 0	3 0 0
162. **Aneroid Barometer,** closed silvered metal dial, in velvet-lined cotton-covered case, with Thermometer	2 10 0	3 5 0
163. **Aneroid Barometer,** open silvered metal dial, in velvet-lined cotton-covered case . .	2 15 0	3 10 0
164. **Aneroid Barometer,** open silvered metal dial, in velvet-lined cloth-covered case, with curved Thermometer	3 3 0	3 15 0
165. **Aneroid Barometer,** 5-in. silvered dial, scale divided to 100th-in., very best compensated	3 3 0	4 4 0
166. **Aneroid Barometer,** 5-in. bevelled plate glass dial, scale divided on the glass to 1-50th-in., case silvered inside—all works visible . .	2 2 0	
167. **Aneroid Barometer,** as preceding, 6-in. transparent dial	2 15 0	
168. **Aneroid Barometer,** 8-in. enamel card dial, with Thermometer	2 2 0	



64.



65.

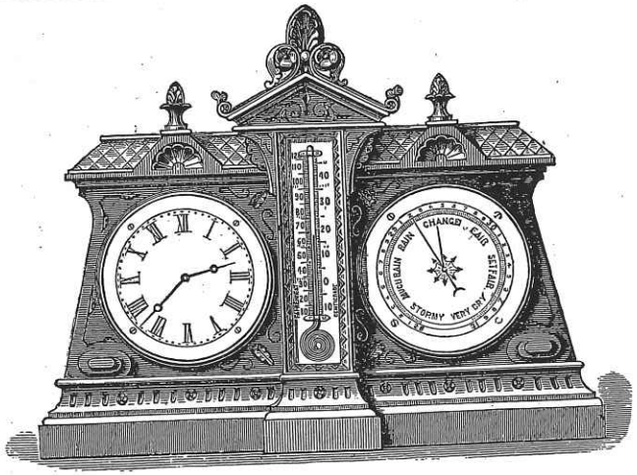


66.

SCALE ABOUT 1-8TH.

MANSION ANEROID BAROMETERS.

	£ s. d.
169. **Aneroid Barometer,** 8-in. silvered dial, Gothic design, castellated top, richly ornate, square centre, carved oak, bevelled glass front, enamel Thermometer, FAHR. and Cent. scales (Fig. 64)	9 0 0
170. **Aneroid Barometer,** 8-in. silvered dial, Ionic design, square centre elegantly carved in solid oak, bevelled glass front, enamel Thermometer, FAHR. and Cent. scales (Fig. 66)	9 9 0
171. **Aneroid Barometer,** 8-in. silvered dial, floral design, elaborately carved round centre, enamel tube, bevelled glass front, spiral Thermometer, FAHR. and Cent. scales (Fig. 65)	7 7 0
172. **Aneroid Barometer,** 10-in. silvered dial, Gothic design, castellated top, same as Fig. 64	10 0 0
173. **Aneroid Barometer,** 10-in. silvered dial, Ionic design, square centre, elegantly carved, same as Fig. 66 .	10 10 0
174. **Aneroid Barometer,** 10-in. silvered dial, floral design, round centre, same as Fig. 65	8 0 0



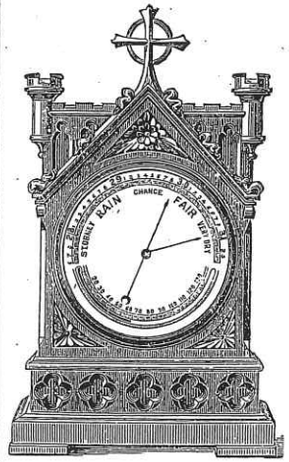
67.

Scale about 1-6th.

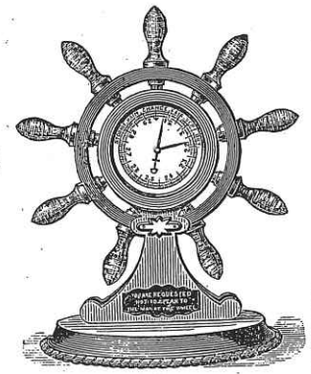
HALL OR LIBRARY ANEROID BAROMETERS.

	£	s.	d.
175. **Library Aneroid,** 5-in. silvered metal dial, ornamental centre, with eight-day clock and spiral bulb Thermometer between, having double scale, mounted in elaborately carved solid oak stand, Egyptian design (Fig. 67) . .	9	9	0
176. **Library Aneroid,** 6-in. silvered dial, ornamental centre, with curved Thermometer in elaborately carved oak or walnut case, castellated design (Fig. 70) . . .	4	4	0
177. **Library Aneroid,** same as preceding, with open face, and Thermometer	4	10	0
178. **Library Aneroid,** 4½-in. silvered metal dial, ornamental centre, in oak or walnut case, ecclesiastical design, bevelled plate glass front, polished edges	4	0	0
179. **Library Aneroid,** 5-in. silvered metal dial, ornamental centre, curved Thermometer, plate glass front, in solid oak frame, shell and fruit design (Fig. 68)	3	10	0
180. **Aneroid Barometer,** 5-in. silvered dial, bevelled plate glass front, enamel Thermometer, Fahr. and Cent. scales, mounted in carved solid oak frame (Fig. 57) .	3	15	0
181. **Aneroid Barometer,** 5-in. silvered dial, ornamental centre, bevelled plate glass front, enamel Thermometer in carved solid oak frame, Ionic design (Fig. 59) . .	4	10	0
182. **Aneroid Barometer,** 6-in. enamel card dial, in carved oak frame, ivy design with clock (Fig. 58) . .	3	15	0
183. **Aneroid Barometer,** 5-in. enamel card open dial, in carved oak frame	1	5	0
184. **Hall Aneroid,** 8-in. enamel card dial, in solid carved oak frame, plate glass front with Thermometer . .	2	0	0
185. **Hall Aneroid,** 8-in. enamel card open dial, in solid carved oak frame, plate glass front with Thermometer .	3	0	0

Aneroid Barometers are, on account of their conveniently small size, specially suitable for use on board ship.



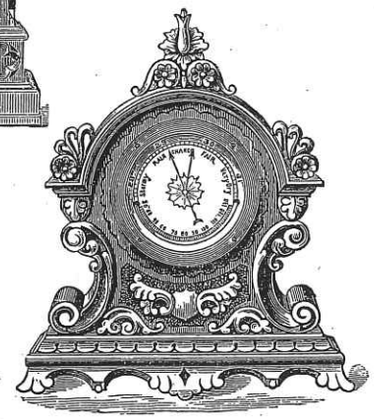
70.



71.



68.

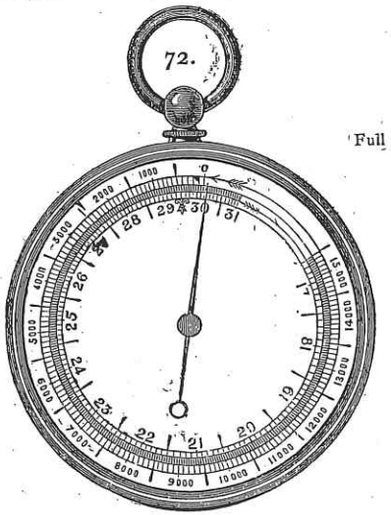


69.

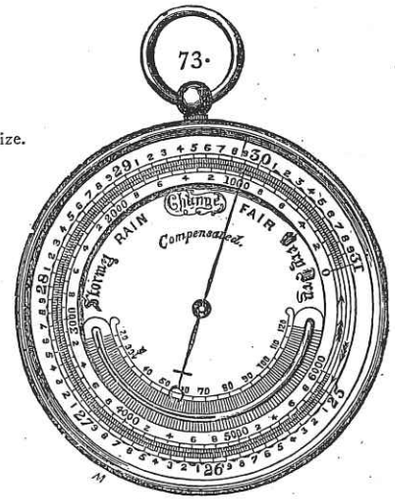
Scale about 1-6th.

ANEROID BAROMETERS.

	£	s.	d.
186. **Aneroid Barometer,** 5-in. metal dial, curved Thermometer, ornamental centre, solid carved oak mount in Renaissance style (Fig. 69)	4	15	0
187. **Aneroid Barometer,** silvered metal dial, plate glass front, in strongly electro-gilt mount steering-wheel design (Fig. 71), 4½-inch dial	12	0	0
187A. **Aneroid Barometer,** 2½-in dial, in highly electro-gilt stand, enamelled blue and white rings, steering-wheel design	7	10	0
187B. **Aneroid Barometer,** same as 187, 2½-in. dial . .	6	10	0
188. **Aneroid Barometer,** same as preceding, with cornelian handles (Fig. 71), 3-in. dial	10	0	0
188A. **Aneroid Barometer,** 2½-in. dial, in highly electro-gilt, mortar design on polished oak carriage	7	10	0
189. **Aneroid Barometer,** 2½-in. dial, in highly electro-gilt, kettle-drum design on gilt tripod stand . . .	4	10	0



Full Size.



POCKET ANEROID BAROMETERS

With silvered dial, in morocco case.

Description.	1¾-inch. Watch size.	2½-inch.	3-inch.	4-inch.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
190. Ordinary range scale .	2 2 0	2 2 0	2 2 0	
191. Do. with Thermometer	2 10 0	2 10 0	2 10 0	
192. Do. open face .	2 15 0	2 15 0	2 15 0	
193. Do. do., and Thermometer* . .	3 0 0	3 0 0	3 0 0	
194. Do. raised dial, curved Thermometer, compensated, "Fair," "Change" and "Rain"	3 5 0	3 10 0	3 10 0	4 4 0

195. **Watch size Pocket Aneroid,** 1¾-in. enamelled dial, metal gilt, in morocco case £ 1 18 6

196. **Watch size (small) Pocket Aneroid,** 1½-in. silvered dial, metal gilt, compensated, in morocco case . . £ 3 5 0

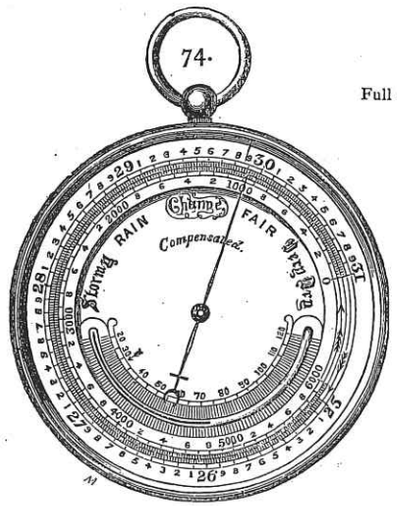
197. **Watch size (small) Pocket Aneroid,** 1½-in. silvered dial, metal gilt, compensated, altitude scale of feet, in morocco case £ 3 10 0

198. **Watch size (small) Pocket Aneroid,** in silver case £ 5 0 0

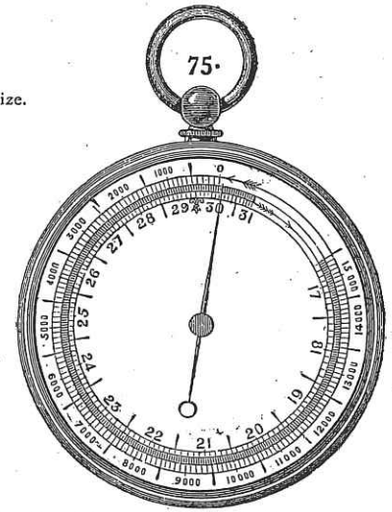
199. **Mining Aneroid Barometer,** 2½-inch raised silver dial, scale of feet from 2000 below sea level to 6000 above, curved Thermometer, in morocco case. This portable Aneroid is specially adapted for engineers and surveyors, enabling them, without calculation, to ascertain heights of mountains and depths of mines £ 3 0 0

* Ordinary range Barometers, compensated for temperature, 5/- each extra. Thermometers to Altitude Barometers, 5/- each extra.

Mountain Aneroids of any diameter, with range of scale to any height or depth.



Full Size.



MOUNTAIN ANEROID BAROMETERS.

All Compensated for Temperature, with silvered dial, in morocco case.

Description.	1¾-inch. Watch size. Metal Gilt.	2½-inch. Lacquered.	3-inch. Lacquered.	4-inch. Lacquered.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
200. Altitude scale, from 6,000 to 10,000 feet .	3 3 0	3 3 0	3 3 0	4 4 0
201. Do. to 15,000 ft.	3 5 0	3 5 0	3 5 0	4 10 0
202. Do. to 20,000 ft.	3 15 0	3 15 0	3 15 0	4 15 0
203. Revolving altitude scale from 6,000 to 10,000 feet, raised dial and curved Thermometer .	3 10 0	4 0 0	4 0 0	4 10 0
204. Do. to 15,000 ft., raised dial . . .	3 15 0	4 10 0	4 10 0	4 15 0
205. Do. to 20,000 ft., raised dial . . .	4 0 0	Gilt 5/6 extra.	Gilt 5/6 extra.	Gilt 10/6 extra.
Above prices for Gilt Metal Cases.				
PRICES EXTRA FOR				
German silver plated .	0 5 6	0 6 6	0 6 6	0 7 6
Standard silver . .	1 10 0	2 5 0	2 15 0	

206. **Mountain Aneroid,** 1¾-inch dial, altitude scale to 10,000 feet inner circle of inches, in morocco case, registered design, having compass and pebble lens in centre to facilitate reading of contracted scale £ 4 15 0

207. **Mountain Aneroid,** 1¾ inch dial, altitude scale to 15,000 feet, in morocco case of registered design, with glass cover having compass in centre, very convenient . £ 4 10 0

208. **Aneroid Barometer,** 5-in. silvered raised dial, scale of feet 18,000 to 21,000, with Thermometer 75/- and £ 4 10 0

209. **Singer's Patent Compass** to 1¾-in. Aneroid, extra for same £ 0 15 6

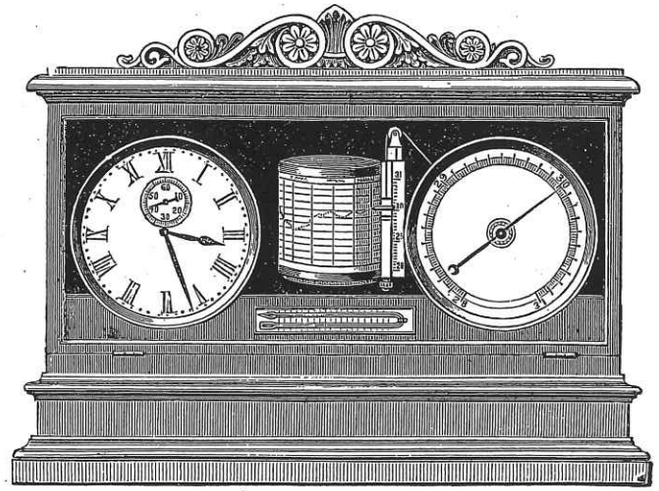
ALTITUDE TABLES

FOR USE WITH THE

ANEROID BAROMETER,

By the ASTRONOMER ROYAL.

Height in Feet.	Aneroid, or Corrected Barometer	Height in Feet.	Aneroid, or Corrected Barometer	Height in Feet.	Aneroid, or Corrected Barometer	Height in Feet.	Aneroid, or Corrected Barometer	Height in Feet.	Aneroid, or Corrected Barometer
ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
0	31·000	2400	28·387	4800	25·994	7200	23·803	9600	21·797
50	30·943	2450	28·335	4850	25·947	7250	23·760	9650	21·757
100	30·886	2500	28·283	4900	25·899	7300	23·716	9700	21·717
150	30·830	2550	28·231	4950	25·852	7350	23·673	9750	21·677
200	30·773	2600	28·180	5000	25·804	7400	23·629	9800	21·638
250	30·717	2650	28·128	5050	25·757	7450	23·586	9850	23·598
300	30·661	2700	28·076	5100	25·710	7500	23·543	9900	21·558
350	30·604	2750	28·025	5150	25·663	7550	23·500	9950	21·519
400	30·548	2800	27·973	5200	25·616	7600	23·457	10000	21·479
450	30·492	2850	27·922	5250	25·569	7650	23·414	10050	21·440
500	30·436	2900	27·871	5300	25·522	7700	23·371	10100	21·401
550	30·381	2950	27·820	5350	25·475	7750	23·328	10150	21·361
600	30·325	3000	27·769	5400	25·428	7800	23·285	10200	21·322
650	30·269	3050	27·718	5450	25·382	7850	23·242	10250	21·283
700	30·214	3100	27·667	5500	25·335	7900	23·200	10300	21·244
750	30·159	3150	27·616	5550	25·289	7950	23·157	10350	21·205
800	30·103	3200	27·566	5600	25·242	8000	23·115	10400	21·166
850	30·048	3250	27·515	5650	25·196	8050	23·072	10450	21·128
900	29·993	3300	27·465	5700	25·150	8100	23·030	10500	21·089
950	29·938	3350	27·415	5750	25·104	8150	22·988	10550	21·050
1000	29·883	3400	27·364	5800	25·058	8200	22·946	10600	21·012
1050	29·828	3450	27·314	5850	25·012	8250	22·904	10650	20·973
1100	29·774	3500	27·264	5900	24·966	8300	22·862	10700	20·935
1150	29·719	3550	27·214	5950	24·920	8350	22·820	10750	20·896
1200	29·665	3600	27·164	6000	24·875	8400	22·778	10800	20·858
1250	29·610	3650	27·115	6050	24·829	8450	22·736	10850	20·820
1300	29·556	3700	27·065	6100	24·784	8500	22·695	10900	20·782
1350	29·502	3750	27·015	6150	24·738	8550	22·653	10950	20·744
1400	29·448	3800	26·966	6200	24·693	8600	22·611	11000	20·706
1450	29·394	3850	26·916	6250	24·648	8650	22·570	11050	20·668
1500	29·340	3900	26·867	6300	24·602	8700	22·529	11100	20·630
1550	29·286	3950	26·818	6350	24·557	8750	22·487	11150	20·592
1600	29·233	4000	26·769	6400	24·512	8800	22·446	11200	20·554
1650	29·179	4050	26·720	6450	24·467	8850	22·405	11250	20·517
1700	29·126	4100	26·671	6500	24·423	8900	22·364	11300	20·479
1750	29·072	4150	26·622	6550	24·378	8950	22·323	11350	20·441
1800	29·019	4200	26·573	6600	24·333	9000	22·282	11400	20·404
1850	28·966	4250	26·524	6650	24·288	9050	22·241	11450	20·367
1900	28·913	4300	26·476	6700	24·244	9100	22·200	11500	20·329
1950	28·860	4350	26·427	6750	24·200	9150	22·160	11550	20·292
2000	28·807	4400	26·379	6800	24·155	9200	22·119	11600	20·255
2050	28·754	4450	26·330	6850	24·111	9250	22·079	11650	20·218
2100	28·701	4500	26·282	6900	24·067	9300	22·038	11700	20·181
2150	28·649	4550	26·234	6950	24·023	9350	21·998	11750	20·144
2200	28·596	4600	26·186	7000	23·979	9400	21·957	11800	20·107
2250	28·544	4650	26·138	7050	23·935	9450	21·917	11850	20·070
2300	28·491	4700	26·090	7100	23·891	9500	21·877	11900	20·033
2350	28·439	4750	26·042	7150	23·847	9550	21·837	11950	19·996
2400	28·387	4800	25·994	7200	23·803	9600	21·797	12000	19·959



76.

SCALE ABOUT 1-8TH.

SELF-RECORDING ANEROID BAROMETER.*

		£	s.	d.
210.	**Self-Recording Aneroid Barometer,** plain top, solid French polished walnut case with plate glass hinged front, open scale to Barometer, minute circle to clock, Dimenuon Thermometer with magnet for adjusting indices, as per description on page 10	21	0	0
211.	**Self-Recording Aneroid Barometer** in French polished walnut case, ornamental top (Fig. 76), glass door, superior eight-day clock, self-registering maximum and minimum Dimenuon Thermometer, and scale of inches on the recording-pencil guide	22	0	0
212.	52 prepared Charts for ditto, sufficient for one year .	1	0	0
213.	104 do. do. sufficient for two years .	1	17	6
214.	208 do. do. sufficient for four years .	4	0	0

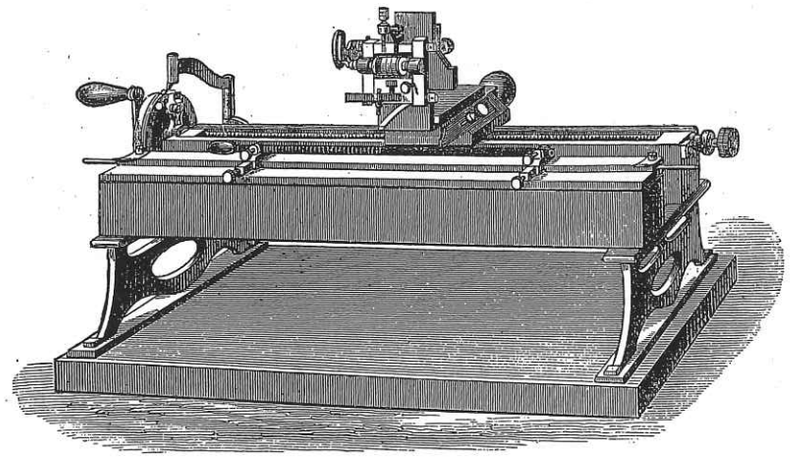
KEW VERIFICATIONS OF BAROMETERS.

The Kew Committee of the Royal Society undertake to verify Barometers with brass scales and verniers,† and, when required, J. J. HICKS will have pleasure in obtaining such verifications for his customers at the following charges:

215.	Standard Barometer, including verification for the attached Thermometer, and carriage to and from Kew	0	10	0
216.	Marine Barometers	0	15	0
217.	Aneroid Barometers, compensated	0	15	0

* For detailed description see page 10.

† Exceptions are sometimes made in the case of ivory scale Barometers.



77.
SCALE ABOUT 1-8TH.

DIVIDING ENGINE.

218. The extreme accuracy now demanded by the meteorologist, the chemist, and the medical man, in the scales of Thermometers, Barometers, and other instruments of precision, renders the use of first-class Dividing Engines absolutely indispensable.

The illustration above shows a beautifully-contrived Divider on RAMSDEN'S principle, of the kind referred to, having a long fine steel screw. The novelties are—First, the wheel at the screw-head, which is divided into 200 or 400 parts, and has cut upon its circumference (which is made broad) a helix screw, in the thread of which runs a detent, carried along by the run of the thread till it meets a stop clamped on the helix at a definite point; this arrests the screw at this point of the motion.

Engines of this construction are in daily use in J. J. HICKS' Factory, and will divide, in the clearest manner, a space of one inch into 250 parts. £50 to £100

Verification of Thermometers.—The Kew Committee of the Royal Society announce their readiness to aid meteorologists in the production of intercomparable observations, by undertaking the verification of instruments sent for that purpose to the Kew Observatory. They are there compared with absolute Standards, and the extent to which they differ, at various parts of their respective scales, duly noted. A copy of this verification is returned with the instrument, the carriage to and from being defrayed by the owner.

The Committee stipulate that the Thermometers must be divided on the stem In accordance with this stipulation, J. J. HICKS will, when desired, have pleasure in forwarding to Kew any instruments of his manufacture, for verification, at the following charges:—

Thermometers—	£	s.	d.
219. Ordinary range, engine-divided on stem . . .	0	1	6
220. Scale reaching to boiling-point on stem . . .	0	3	0
221. Calibrated through entire range of scale . . .	0	6	0

THERMOMETERS.

Though the invention of the Thermometer has been ascribed to various scientific men, it only assumed a practical shape in 1620, at the hands of DREBEL, a Dutch physician. HALLEY substituted mercury for spirit, in 1697; REAUMUR modified the instrument in 1730, and FAHRENHEIT in 1749; CELSIUS improving it in 1742, by adding the scale now known as Centigrade.

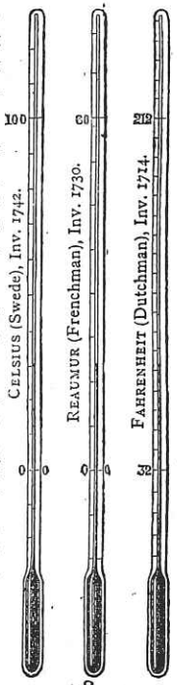
For many years it was exclusively used by chemists and men of science; it afterwards received numerous applications in the arts and manufactures; and, more recently, it is considered an essential in every household.

Thermometers, briefly described, are instruments for measuring degrees of heat by the contraction or expansion of fluids in enclosed tubes. The tubes, which are of glass, have spherical, elongated, or spiral bulbs blown on to one end; they have also an exceedingly fine bore, and, when mercury or spirit is enclosed in them, these fluids, in contracting and expanding with variations of temperature, indicate degrees of heat in relation to two fixed points—viz., the freezing and boiling points of water.

Care is taken to exclude all air before sealing, so that the upper portion of the tube inside shall be a perfect vacuum, and thus offer no resistance to the free expansion of the mercury.

In graduating, or dividing the Scales, the points at which the mercury remains stationary in melting ice and boiling water are first marked on the stem, and the intervening space divided into as many equal parts as are necessary to constitute the scales of CELSIUS, FAHRENHEIT, or REAUMUR.

The following Catalogue will be found to include such a variety as will meet the requirements of all sections of the public.



78.
SCALE ABOUT 1-3RD.

Graduation of Thermometers.—When the fluid (either mercury or spirit) has been enclosed in the hermetically sealed bulbous tube, it becomes necessary, in order that its indications of elevation or depression of temperature may be comparable with those of other instruments, that a Scale having at least two fixed points should be attached to it. Consequently, as it has been observed that the temperature of melting ice or freezing water is always constant, the height at which the fluid *rests* in a mixture of ice and water has been chosen as one point from which to graduate the Scale. It has been further observed that with the Barometer at 29·922 the boiling-point of water is also constant, and when a Thermometer is immersed in pure distilled water heated to ebullition, the point at which the mercury in the tube remains immovable is, like the freezing-point, carefully marked, and is then calibrated and divided into as many equal parts as are necessary to constitute either of the three Scales at present in use, as shown in the illustration.

The zero of the Scales of REAUMUR and Centigrade is the freezing-point of water, marked, in each case, 0°, while the intervening space, up to the boiling-point of water, is divided, in the former case, into 80 parts, and in the latter to 100°.

In the FAHRENHEIT Scale, the freezing-point is represented at 32°, and the boiling-point at 212°, the intervening space being divided into 180°, which admits of extension above and below the points named, a good Thermometer being available for temperature, up to 620° FAHR.

The use of the REAUMUR Scale is confined almost exclusively to Russia and the north of Germany, while the Centigrade Scale is used throughout the rest of Europe. The FAHRENHEIT Scale is confined to England and her Colonies, and to the United States of America.

A variety of circumstances arise in which it becomes necessary to convert readings from one Scale into those of the others, in which cases the following rules are to be observed:—

1. To convert Centigrade degrees into degrees of FAHRENHEIT, multiply by 9, divide the product by 5, and add 32.
2. To convert FAHRENHEIT degrees into degrees of Centigrade, subtract 32, multiply by 5, and divide by 9.
3. To convert REAUMUR degrees into degrees of FAHRENHEIT, multiply by 9, divide by 4, and add 32.
4. To convert REAUMUR degrees into degrees of Centigrade, multiply by 5 and divide by 4.

STANDARD THERMOMETERS.

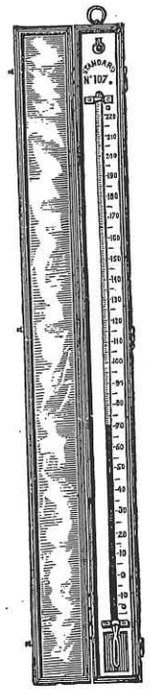
In the construction of Standard Mercurial Thermometers great care is exercised in the selection of tubes of uniform bore throughout their entire length, by the most accurate calibration, an operation which, though it may be briefly described as dividing a tube into parts of equal volume, involves no small amount of experience, and delicacy of manipulation.

The freezing and boiling points of water are then pointed with great care, and the tube itself is engine-divided, into degrees of FAHRENHEIT, Centigrade, or REAUMUR.

221A. **Standard Thermometer,** enamelled tube, scale engine-divided on stem, figured on silvered metal raised piece, 0° to 220°, enclosed in a hinged morocco case, and, if desired, a copy of the index error (for which it is carefully tested) furnished with the instrument £1 15 0

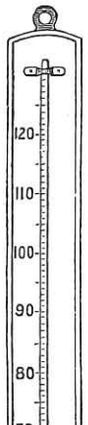
222. **Independent Standard Thermometer** (like Fig. 79), engine-divided on enamel tube, the internal bore of which is accurately calibrated and the value of its parts determined, with extreme precision, by comparison at the freezing and boiling points of water, silvered metal scale, in morocco case. £3 15 0

223. **Comparative Standard Thermometer,** enamel tube, engine-divided, mounted on silvered metal or porcelain scale, mahogany or oak frame, guaranteed correct to 1-10th of a degree. £1 10 0



79.
SCALE ABOUT 1-6TH.

HIGHLY SENSITIVE THERMOMETERS.



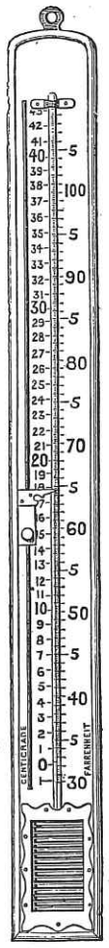
80.

224. **Board of Trade Thermometer,** as used in the Royal Navy and the Meteorological Department of the Board of Trade. Range from 0° to 130°, engine-divided on stem, divided and figured on porcelain or ebonite scale, in copper case (Fig. 80.) £0 10 6

225. ***Highly sensitive Spiral Bulb Thermometer,** enamel tube, open single scale, engine-divided on stem, and figured on boxwood scale, from 10 to 120° F. (Fig. 80A). £1 15 0

226. ***Highly sensitive Gridiron Bulb Thermometer,** enamel tube, open double scale, FAHR. scale engine-divided on stem and Centigrade scale, divided and figured on the boxwood; each degree of both scales divided into 5ths and furnished with a sliding brass index, which can be clamped by a screw, for observing difference of temperature between any two localities, or in any given interval of time. A range of 50° Cent., or 100° FAHR., is extended in this instrument over 18 inches, so that it can be read to 1-10th of a degree by direct observation (Fig. 81). £2 10 0

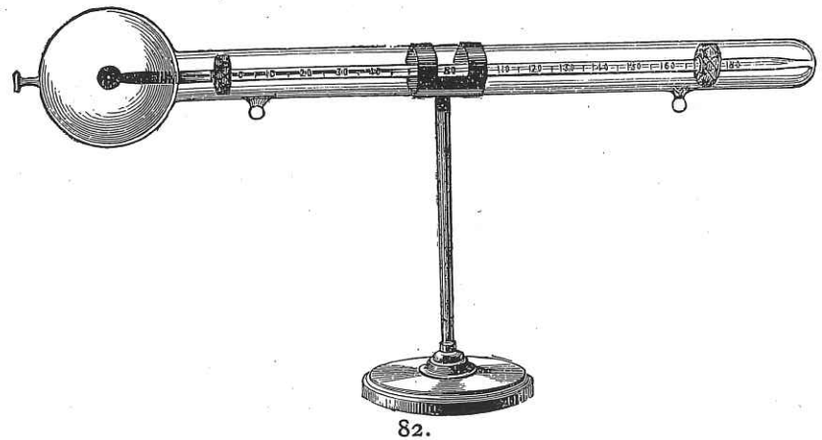
80A.
SCALE ABOUT 1-5TH.



81.
SCALE ABOUT 1-5TH.

	£	s.	d.
227. **Highly sensitive Thermometer,** arranged in sets of 10, from 0° to 212° FAHRENHEIT, the graduation being continuous from No. 1 to No. 10 each scale, including only 20 degrees of one inch to each degree, divided and figured on the stem to twentieths of degrees. These can be had to any range, packed in round metal cases lined with indiarubber each	1	10	0
228. **Sensitive Thermometers,** with very fine bore and small bulbs for physiological research, divided and figured on stem, in boxwood cases lined . . . each	0	15	6

* Similar instruments to these were used by Mr. GLAISHER, in his balloon ascents.



82.

SCALE ABOUT 1-3RD.

HICKS' PATENT SOLAR RADIATION THERMOMETER.

229. Registering maximum, in vacuo, £1 10 0.

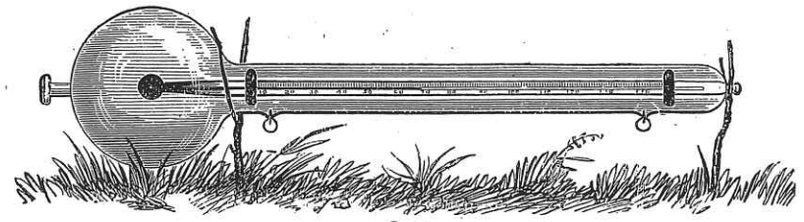
Since the publication of Professor TYNDALL's researches on Radiant Heat, in a volume entitled "Heat considered as a mode of Motion," meteorologists have become more deeply convinced than formerly of the importance of the phenomena connected with Terrestial and Solar Radiation, and there is, consequently, an increasing demand for instruments of precision capable of recording these interesting phenomena.

With the desire to meet this demand, J. J. HICKS has recently devoted much time and attention to the subject; and, in addition to the ordinary Radiation Thermometers, would direct attention to his New Patent Solar Radiation Thermometer, which, while including Mr. STOW's improvement on Sir JOHN HERSCHEL's suggestion, has also a far more perfect vacuum within the enclosing chamber than any hitherto produced.

The following paper, read at a meeting of the Meteorological Society, on Feb. 18th, 1874, describes the instrument:—

"HITHERTO the great difficulty, if not impossibility, of obtaining Solar Radiation Thermometers, which are *strictly intercomparable* for the same circumstances, as regards time and place of exposure to sunshine, has been a source of much perplexity to meteorologists.

"When Sir J. HERSCHEL suggested the introduction of the black-bulb Thermometer into a vacuum chamber made of glass, he certainly did not foresee the extent of uncertainty which has, undoubtedly, been the detrimental characteristic of such instruments. Not only has it been found necessary to supersede the bright black bulb by a dull black one, but Mr. STOW has shown the advisability of dull-blacking also the neck of the Thermometer stem. Moreover, it is to him that the chief credit is due for the endeavour to organise a systematic comparison of these instruments with an assumed standard. There cannot be a doubt but that an appreciable difference in the size of the bulbs causes considerable difference of indication. It is equally certain that a much more important matter is the perfection of the vacuum. As regards this particular, hitherto no certain means of test has been made available for the purpose of ascertaining the amount of air or gas which has been left in the chamber. Some makers, indeed, affirm that in the instrument, as made by them, the air is reduced to 1-120th part of an atmosphere—or say, 0·25 of an inch of mercury in pressure. It is, however, more than probable that the larger number of these instruments have never had a vacuum anything like so perfect; and, from experiments which I have lately made on a large number of instruments, and in a variety of ways, I am led to conclude



83.

SCALE ABOUT 1-3RD.

SOLAR RADIATION THERMOMETER.

230. Black bulb and stem in vacuo, self-registering, £1 7 6

that the vacuum ought to be true to within 1-10th of an inch of pressure, and that it can be brought within 1-50th of an inch without resorting to the Torricellian vacuum, which, except for the presence of mercurial vapour, may be regarded as perfect. It is believed that in perfect vacua these instruments will prove strictly comparable. But it is necessary that the meteorologist should be able at any time to satisfy himself as to the perfection of the vacuum.

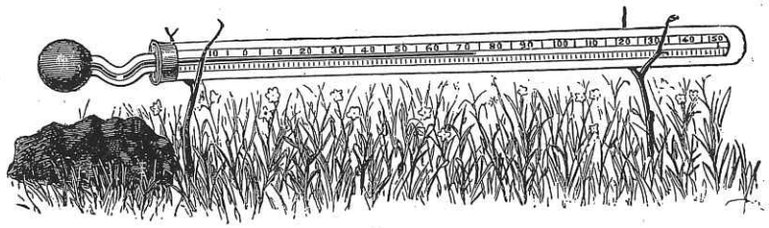
"It occurred to me that the true test for the vacuum would be the passage of an electric current from a RUHMKORFF's coil through the chamber. In NOAD's 'Electricity,' 4th edition, page 742, it is stated that 'In the Torricellian vacuum the inductive spark is white, filling the whole tube;' and J. P. GASSIOT, Esq., F.R.S., has abundantly proved that in Torricellian vacua the discharge of an electric current from a RUHMKORFF's coil, by connecting platinum wires in the glass tube with the terminals of that apparatus, the cylinder is brilliantly illuminated with a dense white phosphorescent light, filling the whole of the vacuum, while cases of stratification and transverse bands can be detected. He found, however, that a small globule of mercury present on one occasion interfered with the effect. He moreover found that the vacuum must be perfect, or within 1-10th of an inch of pressure, and that the slightest trace of moisture must be avoided. I have now succeeded in applying these discoveries of Mr. GASSIOT to the practical purpose of testing the vacua in which it has now for many years been the practice to place Solar Radiation Thermometers. To do this, I insert two platinum wires, one near each end of the glass chamber, in all instruments which I now make. The astonishing result, I find to be, is that a vacuum heretofore deemed sufficiently perfect by the best and most careful makers will not pass the test. I have, however, at length succeeded in making them so that any number, when tested, exhibit the same results. Tried by connecting a syphon pressure gauge, as suggested to me by Mr. R. STRACHAN, the vacua I get are always within 1-20th of an inch, but in most cases within 1-50th of an inch. Any pressure exceeding 1-10th of an inch will not give the test indications, while the pressure of aqueous vapour is shown by a redness in the light. It is necessary that the interior of the chamber should be thoroughly clean and dry: with these conditions, and the proper limits of pressure, the test results are always similar—namely, a pale white phosphorescent light, with faint stratification and appearance of transverse bands. Having experimented largely on all known ways of producing a vacuum, I am now in a position to produce these instruments with better vacua than hitherto beyond comparison, and under conditions that admit of strictly similar electrical tests."

In the discussion following Mr. HICKS' paper, descriptive of his Improved Vacuum Solar Radiation Thermometer, the following observations were made:—

"That the Meeting had placed before them a happy, practical application of a scientific discovery which had hitherto been rather a subject of wonder and delight than of utility. He had read Mr. GASSIOT's Bakerian lecture 'On the Stratification of the Electric Light,' and had found a complete agreement between Mr. HICKS' application and Mr. GASSIOT's discovery. Since Dr. TYNDALL's researches on the powerful action of aqueous vapour on radiant heat, he had always believed that the anomalous results obtained from Solar Thermometers in vacuo were due, if not entirely, in a great measure, to the presence of aqueous vapour. It is, therefore, satisfactory to know that the electric test reveals this moisture."—Mr. STRACHAN.

"The present method seems a great step in advance."—Mr. SCOTT.

"There could be no question as to the value and extreme interest of this method of measuring the degree of exhaustion."—Dr. MANN, F.R.A.S., &c., &c.



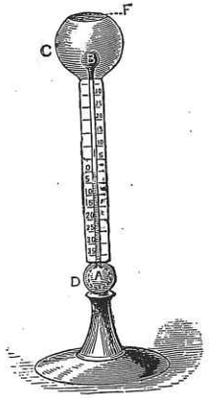
84.

SOLAR RADIATION THERMOMETER.

231. Black Bulb in open air, £0 18 6.

SCALE ABOUT 1-4TH.

The Rev. FENWICK W. STOW, of Hawsker, Yorks., has devoted much attention to the subject of Solar Radiation, and is fairly entitled to the gratitude of meteorologists for his indefatigable exertions to secure *uniformity* in the mode of taking observations, so as to render them intercomparable. He thus directs the manner in which the Solar Radiation Thermometer should be used:—

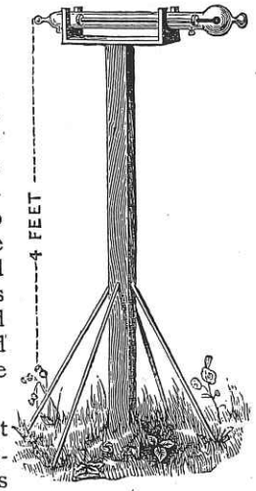


85A.

SCALE ABOUT 1-7TH.

232. ÆTHRIOSCOPE, for estimating terrestrial radiation, £1 10 0

1. Place the instrument four feet above the ground, in an open space (see Fig. 85), with its bulb directed towards the S.E. It is necessary that the globular part of the external glass should not be placed in contact with or very near to any substance, but that the air should circulate round it freely. Thus placed, its readings will be affected only by direct sunshine and by the temperature of the air.



85.

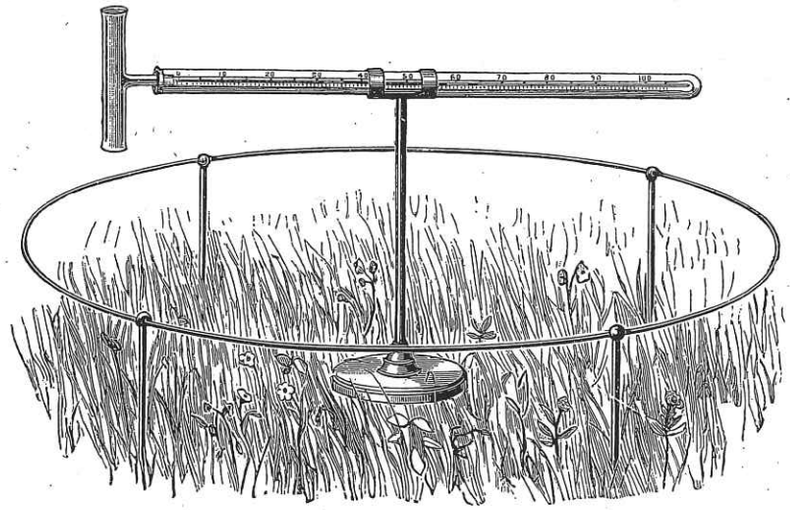
SCALE ABOUT 1-20TH.

233. SOLAR RADIATION THERMOMETER, black bulb and stem in vacuo, on 4-feet stand. £2 10 0, complete.

2. One of the most convenient ways of fixing the instrument will be to allow its stem to fit into and rest upon two wooden collars fastened across the ends of a narrow slip of board, which is nailed in its centre upon a post steadied by lateral supports (Fig. 85).

3. The maximum temperature of the air in shade should be taken by a Thermometer placed on a stand in an open situation. Any stand which thoroughly screens it from the sun, and exposes it to a free circulation of air, will do for the purpose.

4. The difference between the maxima in sun and shade, thus taken, is a measure of the amount of solar radiation.



86.

SCALE ABOUT 1-5TH.

HICKS' PATENT "CYLINDER JACKET" TERRESTRIAL MINIMUM THERMOMETER.

This instrument, having been tested at the Royal Society's Observatory at Kew with the most satisfactory results, and having elicited, at a meeting of the Meteorological Society, on Feb. 18th, 1874, the following laudatory remarks, the descriptive paper read on that occasion, is here reproduced *in extenso*:—

"More sensitive than the Mercurial Standard."—Mr. STRACHAN.

"Very useful where sensitive Thermometers are required."—Dr. TRIPE.

"Great credit is due to Mr. HICKS for this improvement in Spirit Thermometers."—Mr. SCOTT.

"Mr. HICKS' Thermometer was equal (in sensibility) to a Mercurial Thermometer 0·4 inch diameter."—Mr. SYMONS.

"Our mercurial standard is a cylindrical bulb ¼ inch in diameter and ¾ inch in length; and the cylindrical spirit bulb is just about equally sensitive."—Mr. WHIPPLE, Kew Observatory.

"THE Alcohol, or Spirit Thermometer, as ordinarily constructed with a globular bulb, is sluggish in responding to sudden changes of temperature, compared with the Mercurial Thermometer. For this, among other reasons, general preference is given to the Mercurial, although, for some purposes, the Spirit cannot be dispensed with. For very low temperatures it is indispensable; and, though various attempts have been made to produce a Mercurial Thermometer for registering the lowest temperature during a given interval of time, RUTHERFORD'S Spirit Minimum Thermometer is still, practically, the most useful instrument for this purpose.

"In order to render accordant the changes of temperature exhibited by Mercurial and Spirit Thermometers, when placed side by side, especially when the variations are sudden, I have modified the construction of the bulb of the latter Thermometer so as to reduce its cubical contents, and to present as large a surface as possible to the influence of the medium, the temperature of which it is required to indicate: I make the bulb either what I term 'Bottle' shape, or 'Cylinder Jacket' shape.

"The bottle-shape bulb is cylindrical, with the bottom pushed in as much as possible; an exaggerated imitation of some wine bottles. The air, or other fluid medium in which it may be exposed, acting upon the hollow as well as the outside surface, and the stratum of spirit between the glass surfaces being thin, the Thermometer is found to be very sensitive.



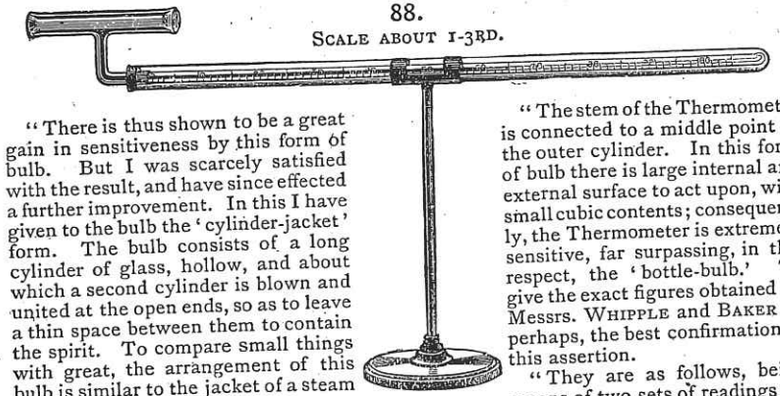
87.

SCALE ABOUT 1-4TH.

"In order to determine the relative sensitiveness of this form of bulb over the ordinary spherical bulb, some experiments were kindly made by Messrs. WHIPPLE and BAKER, at the Kew Observatory. They show that the time which a 'bottle-bulb' Thermometer required to fall through 25° was 55 seconds, whilst a spherical bulb took 145 seconds to fall through the same extent of scale. In rising through the same divisions, the spirit in the one bulb occupied 57 seconds against 144 seconds for the other, which is practically the same as for the fall.

88.

SCALE ABOUT 1-3RD.



"There is thus shown to be a great gain in sensitiveness by this form of bulb. But I was scarcely satisfied with the result, and have since effected a further improvement. In this I have given to the bulb the 'cylinder-jacket' form. The bulb consists of a long cylinder of glass, hollow, and about which a second cylinder is blown and united at the open ends, so as to leave a thin space between them to contain the spirit. To compare small things with great, the arrangement of this bulb is similar to the jacket of a steam cylinder.

"The stem of the Thermometer is connected to a middle point in the outer cylinder. In this form of bulb there is large internal and external surface to act upon, with small cubic contents; consequently, the Thermometer is extremely sensitive, far surpassing, in this respect, the 'bottle-bulb.' To give the exact figures obtained by Messrs. WHIPPLE and BAKER is, perhaps, the best confirmation of this assertion.

"They are as follows, being means of two sets of readings:—

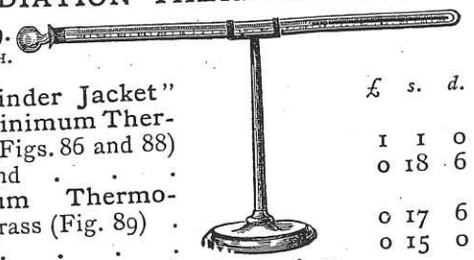
	Range.	Kew Standard Mercurial	Cylinder Bulb	Bottle Bulb	Spherical Bulb
RISING READINGS.	53° to 81° 28°	24″	26″	80″	185″
FALLING READINGS.	81° to 53° 28°	31″	42″	87″	187″

"Mr. WHIPPLE says:—'Undoubtedly the falling readings take longer to attain than 'the rising, but really the difference is trifling. Our method of experimenting has been 'to take two verification jars side by side, one with water at 53°, the other at 81°, 'knowing the temperature by independent Thermometers. Then, with all the experi-'mental Thermometers fixed on the same frame, plunge them out of one jar into 'the other, and take time at which they acquire the new temperature. Our mercurial 'standard is a cylindrical bulb ¼ inch in diameter and ¾ inch in length; and the cylin-'drical spirit bulb is just about equally sensitive.'

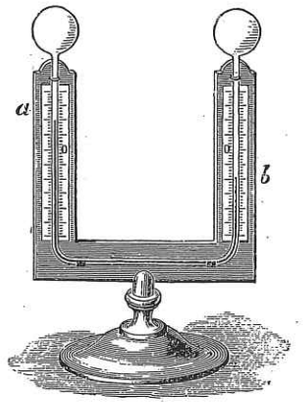
TERRESTRIAL RADIATION THERMOMETERS.

89.

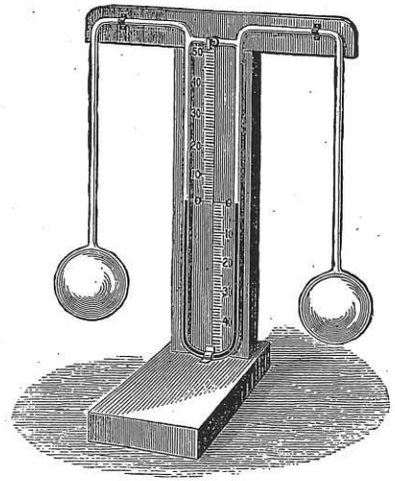
SCALE ABOUT 1-6TH.



	£	s.	d.
234. **Hicks' Patent "Cylinder Jacket" Terrestrial Radiation Minimum Thermometer,** on brass stand (Figs. 86 and 88)	1	1	0
235. Ditto ditto, without stand	0	18	6
236. **Terrestrial Minimum Thermometer,** on stand, for the grass (Fig. 89)	0	17	6
237. Ditto ditto, small size	0	15	0
238. **Concave Metallic Reflector,** on brass stand to accompany Terrestrial Minimum Thermometer	0	5	6
239. **Hicks' Patent Bottle Bulb Minimum Thermometer** on stand	0	18	6
240. Ditto ditto, without stand (Fig. 87)	0	15	6



90.



91.

SCALE ABOUT 1-9TH.

LESLIE'S & MATTHIESSEN'S DIFFERENTIAL THERMOMETERS.

241. **Leslie's Differential Thermometer** (Fig. 90) was constructed by Sir JOHN LESLIE, for showing the *difference* of temperature between two places, hence its name. It consists of two bulbs containing air united by a tube bent twice at right angles and fixed on a frame. Sufficient coloured fluid is introduced to completely fill the horizontal tube and half of each of the vertical joints, and the scale is then graduated, zero being marked at each end of the column of fluid. On the application of heat to one bulb the fluid rises nearly to the top of the other stem; this point is marked 10°, and the distance between it and zero divided into 10 equal parts. The instrument is much used for delicate experiments on radiant heat. With Ivory Scales . £0 17 6

242. Boxwood do. 0 15 6

243. **Rumford's Thermoscope** resembles LESLIE'S Differential Thermometer in construction, but differs from it in having the bulbs supported on very much shorter vertical stems, while the horizontal connecting tube is much longer, and instead of having a large quantity of spirit, it simply bears a moving alcohol index about half-an-inch in length, which, when the bulbs are at the same temperature, remains stationary in the centre of the horizontal tube. Ivory scale £0 17 6

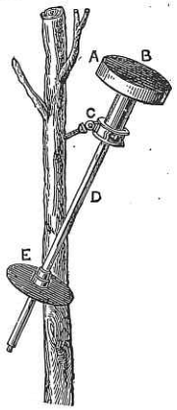
244. Boxwood ditto 0 15 6

245. **Matthiessen's Differential Thermometer.**—It will be seen by the engraving (Fig. 91) that Professor MATTHIESSEN'S Differential Thermometer, while applicable in all cases where LESLIE'S might be used, is also specially convenient for ascertaining the temperature of *liquids*, on account of the pendant position of the bulbs. A glass stopcock connects the two limbs and forms a convenient mode of adjusting the level of the liquid, a task not so readily accomplished in the LESLIE form of apparatus. With Ivory Scales . . £1 8 6

246. Boxwood do. 1 5 6

PYRHELIOMETER, ACTINOMETER, &c.

247. **Pyrheliometer.**—This apparatus, originally devised by M. POUILLET, is intended to register the heating power of parallel solar rays by the amount of heat imparted to a disc of a given diameter in a given time. It consists of a flat circular vessel of steel having its outside coated with lamp-black. A short steel tube is attached to the side opposite to that covered with lamp-black, and the vessel is filled with mercury. A registering thermometer, protected by a brass tube, is then attached, and the whole is inverted and exposed to the sun, as shown in the figure. The purpose of the second disc, at the lower end, is to aid in so placing the apparatus that it shall receive direct parallel, and not oblique rays. It will be at once apparent that if the shadow of the upper disc completely covers the lower one, the sun's rays must be falling perpendicularly on its blackened surface. Fig. 92 £4 0 0



92.
SCALE ABOUT 1-8TH.

248. **Herschell's Actinometer.**—This instrument was designed by Sir JOHN HERSCHELL for observing the heating power of the sun's rays in a given time. It consists of a thermometer with a long open scale and a large cylindrical bulb, thus combining the best conditions for extreme sensibility. An observation is made by exposing the instrument in the shade for one minute and noting the temperature. It is then exposed to the sun's rays for one minute, and a record of the temperature made. It is again placed in the shade for one minute, and finally the mean of the two shade readings being deducted from the solar reading shows the heating power of the sun's rays for one minute of time. Fig. 93 . £5 15 0

248a. **Hodgkinson's Actinometer,** complete, with two Thermometers, in case £4 15 0


93.
SCALE ABOUT 1-8TH.

BOILING-POINT THERMOMETER.

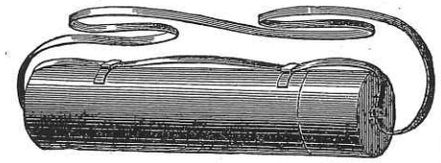
The temperature at which water boils depends on the pressure of the atmosphere, and a liquid is in a state of ebullition when it gives off vapour of the same tension as the surrounding air. According to DESCHANEL, "just as we can determine the boiling point of water when the external pressure is given, so if the boiling point be known we can determine the external pressure. In either case we have only to refer to a table of maximum tensions of aqueous vapour at different temperatures."

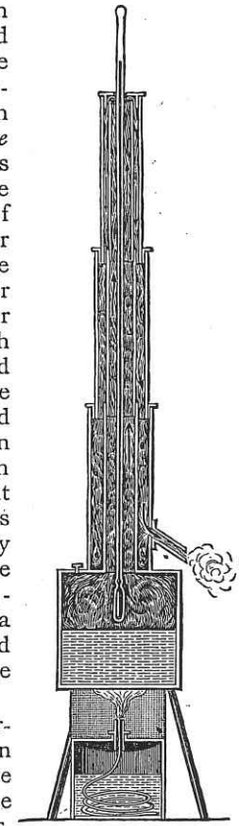
These facts induced WOLLASTON to attempt the determination of heights of mountains by an apparatus which he called the Barometric Thermometer, subsequently modified by REGNAULT in a smaller size, and called a Hypsometer, but now more generally known as a Boiling-Point Thermometer.

Dr. J. D. HOOKER, in his "Himalayan Journals," says "For the elevation of great mountain masses and continuously elevated areas, I conceive that hypsometrical results are as good as barometrical ones; for the general purposes of botanical geography the Boiling-Point Thermometer supersedes the Barometer in point of practical utility."

BOILING-POINT THERMOMETERS.

249. **Wollaston's Boiling-Point Thermomter** is shown in section in the margin, and consists of a delicate 12-inch Thermometer with scale engine-divided and figured on stem from 180° to 212°, each degree being subdivided to 0·1°. To avoid errors from the cooling influence of atmospheric currents, the Thermometer is suspended from an india-rubber washer to within an inch and a half of the water inside a *double* three-draw telescope chamber, to prevent currents of air affecting the temperature, and thus the Thermometer is surrounded by the vapour of boiling water only. The steam ascends the inner chamber, escaping by a hole at the top into the outer one, which it descends to reach the open air through the tube at the side. The copper boiler on tripod stand is supplied with water through a small opening at the top to about one-third its capacity, the spirit lamp is then ignited. The mercury will soon be seen to ascend, and the division on the stem at which it becomes stationary shows the temperature, and a reference to the tables, supplied with each instrument, will give the elevation in feet above sea level.


94.
SCALE ABOUT 1-6TH.

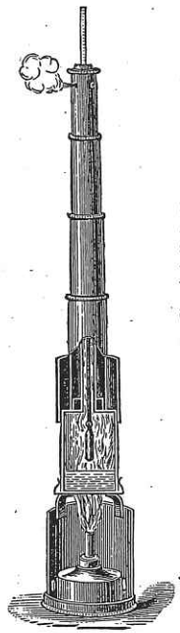

95.
SCALE ABOUT 1-5TH.

The temperature of the surrounding air, as indicated by an extra Thermometer, should be noted at the time of making the experiment. The Thermometer is packed in a light metallic case lined with india-rubber, and the whole is enclosed in leather case with straps, as shown in Figs. 94 and 95 £4 15 0

250. **Extra Thermometers** in metal case, each 21/-

251. **Pocket Hypsometrical Apparatus.**—This is a more portable form of the WOLLASTON Boiling-Point Thermometer, and, on account of its simplicity, much used by Alpine Travellers; it is cheap and efficient, and forms a trustworthy check on the Aneroid Barometer. The illustration (Fig. 96) shows the instrument with the Telescope portion drawn out for use. The lamp is protected from wind by a perforated japanned tin case covered with wire gauze.

With one Thermometer divided to 1-5th of degrees. £2 10 0


96.
SCALE ABOUT 1-3RD.

252. **Extra Thermometers** in metal case, each 15/-

HENDERSON'S SELF-REGISTERING, BOILING-POINT THERMOMETER.

Dr. HENDERSON, Officiating Superintendent of the Botanic Gardens, Calcutta, in his account of the expedition from Lahore to Yarkand, in 1870, thus speaks of this very superior Boiling-Point Thermometer:—

"Mr. J. HICKS, of 8, Hatton Garden, has carried out my ideas in a way which renders the instrument perfect. The difficulty of replacing an exhausted supply of spirit for the lamp, and the probability of waste by spilling, are familiar to those who have made hypsometrical experiments. The apparatus I have invented, and of which a woodcut is here given, has the following advantages:—

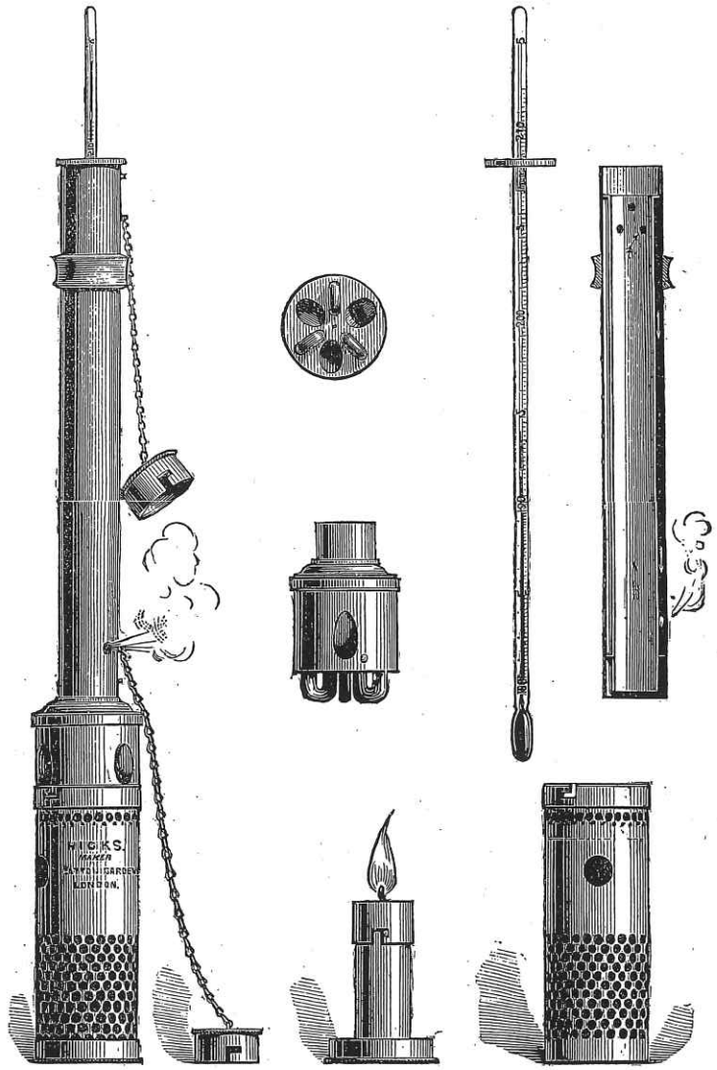
"1. The water is made to boil by the heat of a candle, which gives a uniform source of heat; and a measured quantity of water (about ¼ oz.) being used, the results are extremely uniform. Composition candles are easily carried, and are now obtainable almost everywhere. The piece of candle, about two inches long, which is used for boiling the Thermometer, is pushed up by means of a spiral spring, as in an ordinary carriage lamp.

"2. My Thermometer is a self-registering maximum one, which I find can be carried to some distance without moving the index.

"3. The brass tube in which the Thermometer is boiled forms the case for carrying it in the pocket.

"4. To prevent the detached piece of mercury which forms the index from being shaken down into the bulb, Mr. HICKS makes the Thermometer with a constricture just above the bulb; but should the index, in spite of this arrangement, coalesce with the bulk of the mercury in the bulb, the instrument may be again made self-registering in the following way, which consists in gently tapping the bulb of the Thermometer on the palm of the hand, until a small portion of mercury breaks off into the neck. The operation requires some delicacy and dexterity, but may be performed with due care."

	£	s.	d.
253. **Henderson's Boiling Point Apparatus**, complete with one Thermometer	3	3	0
254. **Extra Thermometer**, in india-rubber lined metal case	1	0	0



97.

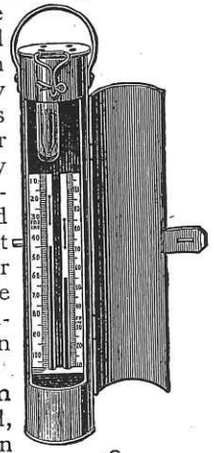
SCALE ABOUT ½RD.

HENDERSON'S SELF-REGISTERING, BOILING-POINT THERMOMETER.

DEEP SEA THERMOMETERS.

There are three modifications of Thermometers for the registration of deep sea maximum and minimum temperatures, but that at present in general use in the Royal Navy (on board H.M.S. Challenger) is a modification of Six's.

In the earlier experiments made for ascertaining the temperature of the ocean at a depth of 15,000 feet where the pressure is equal to three tons on the square inch, it was found that a considerable error occurred in the indications in consequence of this enormous pressure; accordingly the central elongated bulb of the ordinary Six's Thermometer, is shortened and enclosed in an outer bulb nearly filled with spirit, which, while effectually relieving the Thermometer bulb from undue pressure allows any change to be at once transmitted to it, and thus secure the registration of the exact temperature. The arrangement possesses the further advantage of making the instrument stronger, more compact, and more capable of resisting such comparatively rough treatment as it would receive on board ship.



98.
SCALE ABOUT 1-5TH.

255. **Deep Sea Maximum and Minimum Registering Thermometer** (Fig. 98), as described, in ebonite mounting, divisions and figures on German silver raised scales at side, acting also as a protection to the Thermometer, in round copper case, with hinged door and clasps £2 0 0

256. **Johnson's Deep Sea Metallic Thermometer** (Fig. 99) depends for its indications on the unequal contraction and expansion of compound metallic bars. Strips of brass and steel are riveted together, and when heated the brass expands more than the steel, the bar will be found to assume a slight curve in one direction while a contraction of the brass in excess of the steel from a reduction of temperature will impart a curve in the opposite direction . . £6 6 0

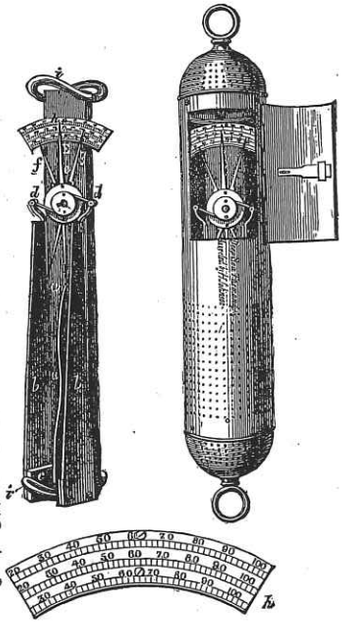
257. **Six's Thermometer,** 12-in. or 14-in., on metal or porcelain scale in round copper case, with door and ring at bottom for weight, with valves. £1 12 6

258. Ditto, without valves £1 8 6

259. **Ordinary Thermometer,** 8-in. enamel tube in copper case with valves, on metal or porcelain scale 18/6

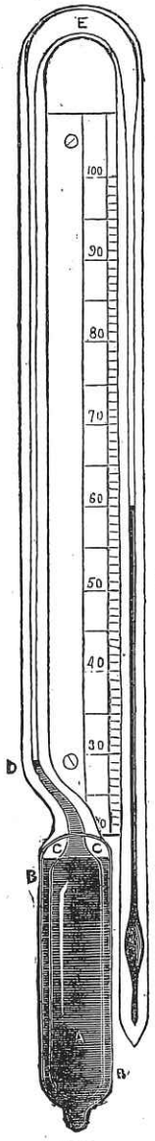
260. Ditto ditto, 10-in., 22/-; 12-in., 25/-

261. Ditto ditto, without valves, 8-in., 12/6; 10-in., 15/6; 12-in., 18/6.

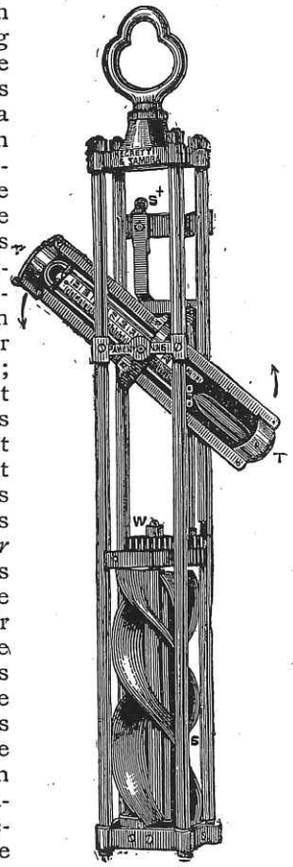


99.
SCALE ABOUT 1-8TH.

262. **Negretti and Zambra's Patent Deep Sea Self-registering Thermometer.** This is a most ingenious contrivance. It has no indices or springs, and its indications are by the column of mercury only. The bulb of the Thermometer is so protected as to resist the pressure of the ocean, which varies according to depth, being at 3000 fathoms about three tons on the square inch. This instrument is, in shape, like a syphon, with parallel legs all in one piece, and has a continuous communication, as in the accompanying Fig. 100. The scale of the Thermometer is pivoted on a centre, and is attached in a perpendicular position to a simple apparatus. In its descent the Thermometer acts as an ordinary instrument; but, so soon as the descent ceases, and a reverse motion is given to the line, the instrument turns once on its centre, first bulb uppermost, and afterwards bulb downwards. Fig. 100 shows the portion of the mercury *after* the instrument has been thus turned on its centre. A is the bulb; B, the outer coating, or protecting cylinder; C is the space of rarefied air, which is reduced if the outer casing be compressed; D is a small glass plug, which ensures that none but the mercury in the tube can be transferred into the indicating column; E is an enlargement made in the bend, to enable the mercury to pass quickly from one tube to another in revolving; and F is the indicating tube, or Thermometer proper. When the Thermometer is put in motion, and immediately the tube has acquired a slightly oblique position (Fig. 101), the mercury breaks off at the point D, runs into the curved and enlarged portion E, and eventually falls into tube F, when this tube resumes its original position. The contrivance for turning the Thermometer over at the bottom of the sea is a vertical propeller G (Fig. 101), to which the instrument is pivoted. The engraving (Fig. 101) shows the general arrangement—T being the Thermometer; S, a metal screw connected with the frame of the Thermometer by a wheel and pinion movement at W; S* is the stop for arresting the movement of the Thermometer when it has made one revolution.



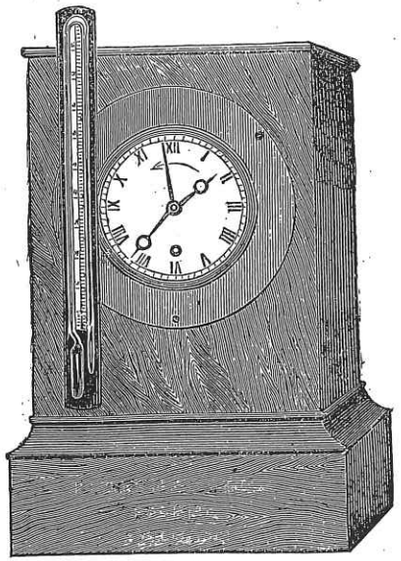
100.
SCALE ABOUT ½.



101.
SCALE ABOUT 1-7TH.

SELF-RECORDING THERMOMETER, &c.

263. The **Atmospheric Recording Thermometer** (Fig. 102) differs from the Deep Sea Thermometer, by its not having the double, or protected bulb, it not being required for resisting pressures. In this case, the instrument is turned over by a simple clock movement, which can be set to any hour.

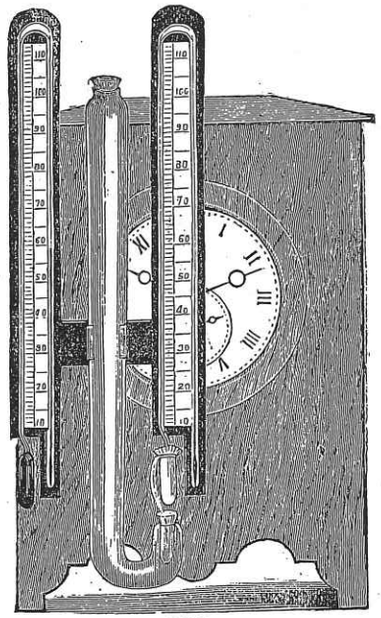


102.

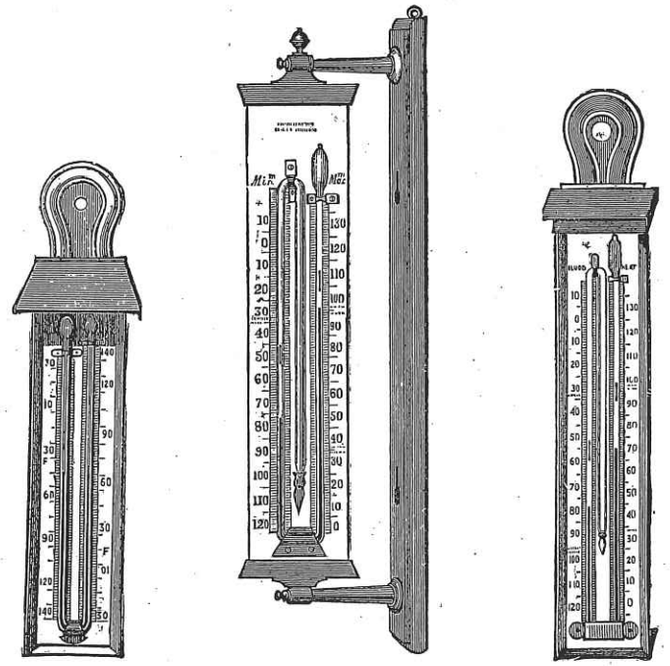
The Thermometer is fixed on the clock, and when the hand arrives at the hour determined upon, and to which the clock is set, as in setting an alarum clock, a spring is released and the Thermometer turns over, and thus registers the temperature.

264. **A Wet and Dry Bulb Hygrometer** is also arranged on the same plan (Fig. 103).

For observatories, or where it is important to obtain hourly or half-hourly records of the variations of temperature, twelve or more Thermometers are placed on a frame, and these are turned over by clock-work, one after the other, at every hour or half-hour, as desirable.



103.



104. 105. 106.

SCALE ABOUT 1-7TH.

SIX'S THERMOMETER.

SIX's Thermometer, for registering extremes of heat and cold, was invented by Mr. JAMES SIX, of Canterbury, about 1790. When well made it is a most trustworthy instrument, and the principle being good, it remains essentially the same as when invented.

It consists of a long tubular bulb, united to a smaller tube more than twice its length, and bent twice, like a syphon, so that the larger tube is in the centre, while the smaller one terminates at the top, on the right hand, in a pear-shaped bulb, as shown in the cut. This bulb, and the tube in connection with it, is partly filled with spirit; the long, central bulb, and its connecting tube, are completely filled, while the lower portion of the syphon is filled with mercury. A steel index, prevented from falling by a hair tied round it, to act as a spring, moves in the spirit in each of the side tubes.

The scale on the left hand, for indicating minimum temperatures, is a descending one, the zero being at the top; while the right hand scale, for maximum temperatures, is an ascending one, having the zero at the bottom.

When setting the instrument to register extremes of heat and cold, the indices are brought into contact with the mercury by passing a small magnet down the outside of each tube. Then, should a rise of temperature take place, the spirit in the central bulb expands, forcing down the mercury in the left hand tube and causing it to rise in the right, which it does also partly by its own expansion. The reverse of this occurs when a diminution of temperature takes place—contraction

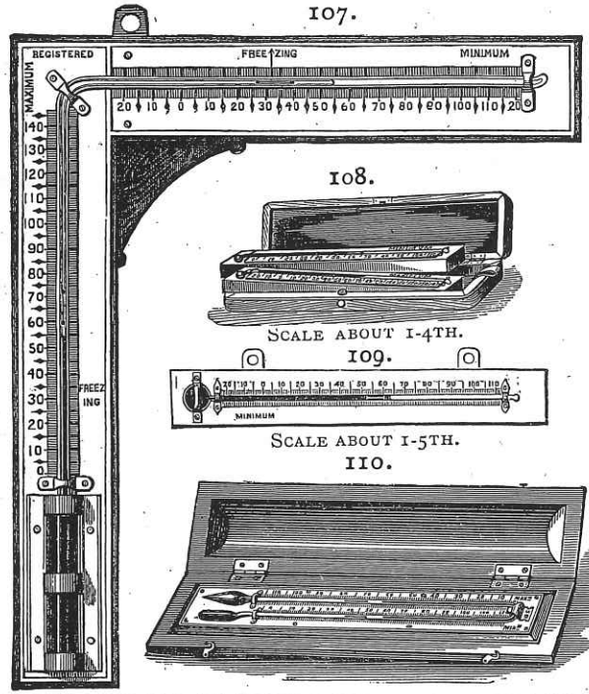
in all the contained fluids result, and the registering mercury ascends in the left hand column, pushing the index before it, where it remains until re-adjusted for the next observation.

This Thermometer should be always used and carried upright, and the indices should be drawn *gently* down by the magnet into contact with the mercury; and, when a reading is taken, the end of the index nearest the mercury indicates the maximum and minimum temperatures which have been attained during the stated hours of observation.

SIX'S THERMOMETERS.

	£	s.	d.
265. **Six's Thermometer**, 20-inch porcelain scale, bold figures, on oak board, with brackets to revolve (Fig. 105)	2	5	0
266. **Six's Thermometer**, porcelain or transparent glass scale, on oak board, with brackets to revolve, 16-inch, 35/-; 14-inch, 32/6; 12-inch, 30/-; 10-inch	1	5	0
267. **Six's Thermometer**, 20-inch porcelain scale, with back plates top and bottom	1	15	0
268. **Six's Thermometer**, 18-inch porcelain scale, with back plates top and bottom	1	10	0
269. **Six's Thermometers**, enamel glass scale, plain tube, open back case, 14-inch, 21/-; 12-inch, 18/6; 10-inch, 16/6; 8-inch.	0	13	6
270. **Six's Thermometers**, enamel tube, porcelain scale, in white japanned case, 14-inch, 21/-; 12-inch, 18/6; 10-inch, 16/6; 8-inch (Fig. 106)	0	13	6
271. **Six's Thermometer**, 10-inch porcelain scale, with two bulbs at top, in japanned case	0	17	6
272. **Six's Thermometers**, enamel tube, zinc scales, white japanned case, 14-inch, 17/6; 12-inch, 15/6; 10-inch, 12/6; 8-inch	0	10	6
273. **Six's Thermometers**, plain tube, zinc scales, black japanned case, 14-inch, 16/6; 12-inch, 14/6; 10-inch, 12/6; 8-inch	0	10	0
274. **Six's Thermometers**, boxwood scale, enamelled tube, black japanned case, 12-inch, 14/6; 10-inch, 12/-; 8-inch	0	9	0
275. **Six's Thermometers**, boxwood scale, plain tube, black japanned case, 12-inch, 13/6; 10-inch, 10/-; 8-inch (Fig. 104)	0	7	6
276. **Six's Thermometers**, boxwood scale, round top, enamel tube, 10-inch, 11/6; 8-inch	0	8	0
277. **Six's Thermometers**, boxwood scale, round top, plain tube, 10-inch, 10/6; 8-inch	0	7	6
278. **Six's Thermometer**, enamel tube, ivory scale, in Morocco case, 8-inch	0	17	6
279. **Six's Thermometer**, enamel tube, ivory scale, mahogany or boxwood case, 7-inch	0	12	6
280. **Six's Thermometers**, enamel tube, opal or porcelain scales, on polished ebony or boxwood backs, 14-inch, 24/-; 12-inch, 21/-; 10-inch, 18/6; 8-inch . . .	0	15	6

107.



108.

SCALE ABOUT 1-4TH.

109.

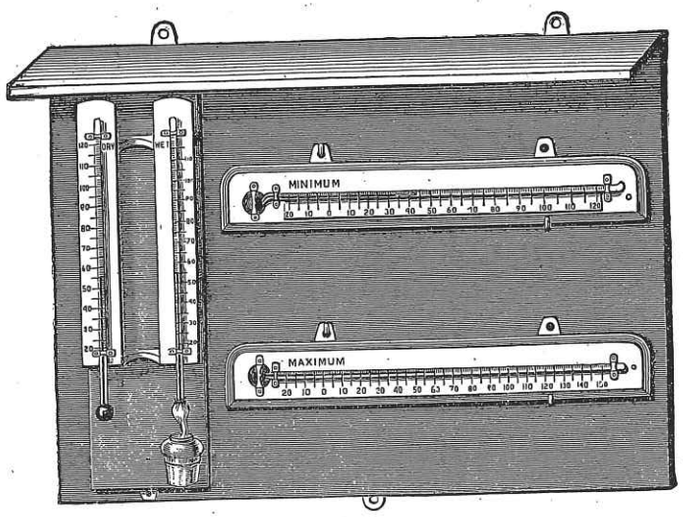
SCALE ABOUT 1-5TH.

110.

HICKS' SELF-REGISTERING MERCURIAL MAXIMUM AND MINIMUM THERMOMETER.

The source of the indications is mercury, by the use of which, equal divisions are permissible throughout the entire range of the maximum and minimum scales; and as, in consequence, the divisions below 32° are not contracted as in the ordinary spirit minimum thermometer, they are absolutely correct, and, by a special arrangement, the maximum forms a certain test of the accuracy of the minimum indications.

	£	s.	d.
281. **Hicks' Self-registering Mercurial Maximum and Minimum Thermometer**, opal glass scales, mounted on mahogany boards (Fig. 107)	1	15	0
282. **Hicks' Self-registering Mercurial Maximum and Minimum Thermometer**, as 281, on boxwood scales .	1	10	0
283. **Dimenuon Self-registering Maximum and Minimum Thermometer**, similar in construction to Six's, but used horizontally; floating indices adjustable with or or without a magnet, porcelain scale in white japanned metal case, 10-in. 18/6; 8-in. 15/6; 6-in.	0	13	6
284. **Dimenuon Self-registering Thermometer**, same as preceding, boxwood scales, 10-in. 13/6; 8-in. 12/6; 6-in.	0	11	6
285. **Dimenuon Self-registering Thermometer**, for Tourists, silvered metal scale on mahogany backs in solid mahogany case, 8-in. 25/-; 6-in. 23/-; 5-in. (Fig. 110) .	1	1	0
286. **Dimenuon Self-registering Thermometer**, same as preceding, ivory scales, in Morocco case with snap, 8-in. 17/6; 6-in. 14/6; 5-in.	0	12	6



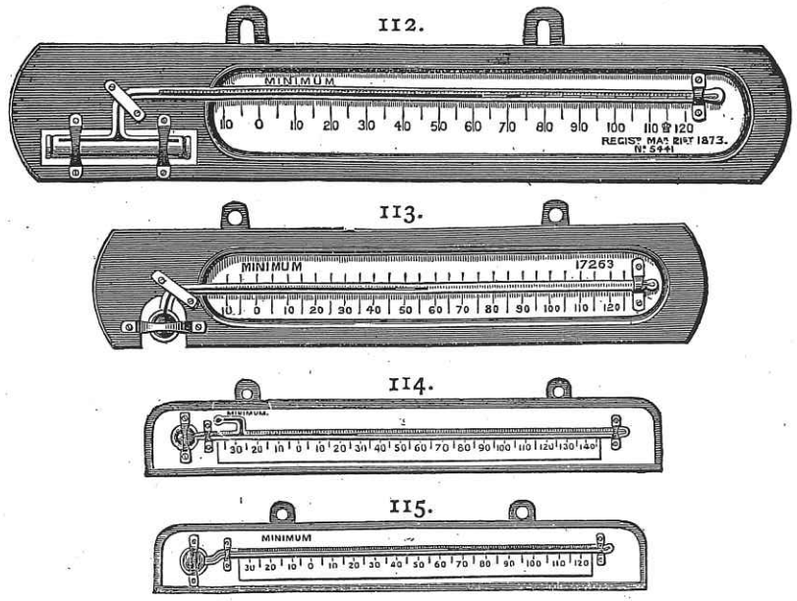
III.

Scale about 1-6th.

SET OF STANDARD INSTRUMENTS ON SCREEN.

	£	s.	d.
287. **Set of Standard Maximum and Minimum 14-inch Thermometers and Mason's Hygrometer** on mahogany board (Fig. 111). These instruments are engine-divided on the stem, and divided and figured on porcelain or enamel glass scales, on oak backs . .	3	15	0
288. **Set of Standard Maximum and Minimum 14-inch Thermometers and Mason's Hygrometer,** same as preceding, on deal board	3	10	0
289. **Set of Standard Maximum and Minimum 10-inch Thermometers and Mason's Hygrometer,** same as preceding, on deal board	2	7	6
290. **Set of Maximum and Minimum 10-inch Thermometers and Mason's Hygrometer** on deal board, figured and divided only on porcelain scale . .	2	0	0
291. **Educational Set of Meteorological Instruments,** for the use of schools and families, including a good round top Barometer with ivory scale, vernier and attached Thermometer, one each self-registering maximum and minimum Thermometers, a Mason's Hygrometer with porcelain scales, and Glaisher's Rain Gauge with graduated measure	4	4	0

Although this set does not contain absolute standard instruments, they possess sufficient accuracy for ordinary observations, and the selection can be modified to meet the special requirements of different purchasers.

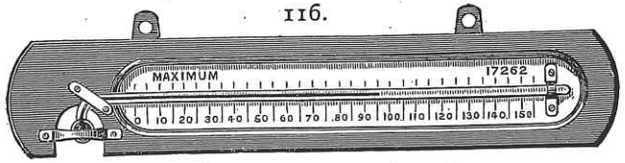


Scale about 1-5th.

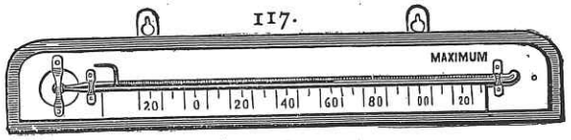
MINIMUM THERMOMETERS.

	£	s.	d.
292. **Hicks' Patent Cylinder Jacket Mimimum Thermometer,** engine-divided on stem, divided and figured on porcelain or enamel glass scale, mounted in solid mahogany frame. The most sensitive Minimum Thermometer ever made (Fig. 112)	1	5	0
293. **Standard Minimum Thermometer,** engine-divided on stem, figured and divided on porcelain or opal glass scale, mounted in solid mahogany frame (Fig. 113) .	0	18	6
294. **Mercurial Minimum Thermometer,** engine-divided on stem, figured and divided on raised porcelain scale, mounted on oak (Fig. 114)	1	10	0
295. **Best Standard Minimum Thermometer,** 14-inch porcelain scale, on oak, engine-divided on stem and figured on scale (Fig. 115)	0	17	6
296. **Minimum Thermometer,** 10-inch porcelain scale, printed on scale (Fig. 109)	0	3	6
297. **Minimum Thermometer,** 10-inch porcelain scale, engine-divided on stem	0	7	6
298. **Minimum Thermometer,** 10-inch porcelain scale .	0	6	6
299. **Minimum Thermometer,** 10-inch porcelain scale, on oak, engine-divided on stem and figured on scale .	0	8	6
300. **Minimum Thermometer,** 10-inch porcelain scale on oak	0	7	6
301. **Minimum Thermometer,** 12-inch solid porcelain scale, engine-divided on stem and figured on scale .	0	10	6
302. **Minimum Thermometer,** on 12-inch solid porcelain scale	0	9	6

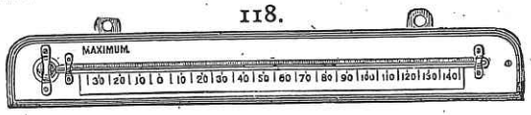
116.

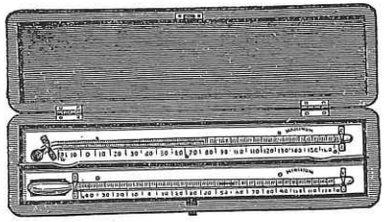


117.



118.

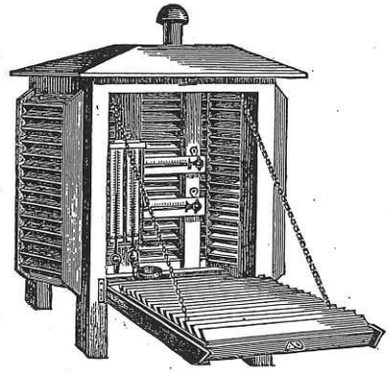




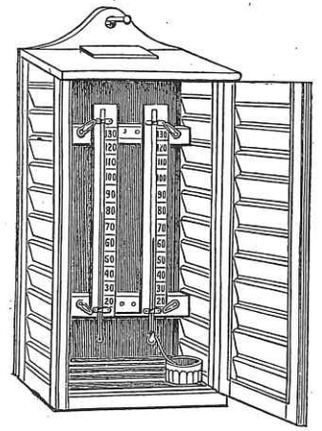
119.
SCALE ABOUT 1-5TH.

MAXIMUM THERMOMETERS
(Self-registering).

	£	s.	d.
303. **Maximum Thermometer**, engine-divided on stem, divided and figured on opal glass scale, mounted in solid mahogany frame, on any plan, as required (Fig. 116) .	0	18	6
304. **Hicks' Patent Maximum Thermometer**, divided on the stem, with porcelain or opaque glass scale, on oak (Fig. 117)	1	1	0
305. **Hicks' Patent Self-registering Thermometer** on boxwood scale	0	13	6
306. **Maximum Thermometer**, solid porcelain 12-inch scale, tube engine-divided on stem and figured on scale .	0	12	6
307. **Maximum Thermometer**, divided and figured on 12-inch solid porcelain scale	0	11	6
308. **Best Standard Maximum Thermometer**, divided on stem, with porcelain or opaque glass scale, on oak, 14-in. (Fig. 118)	0	17	6
309. **Maximum Thermometer**, 10-inch porcelain scale, on oak, engine-divided on stem and figured on scale .	0	10	6
310. **Maximum Thermometer**, 10-inch, divided and figured on porcelain scale	0	9	6
311. **Livingstone's Maximum and Minimum Thermometers**, divided on the stem, on ivory or metal scales, in mahogany or morocco case (Fig. 119) . . 25/- to	1	10	0



120.
SCALE ABOUT 1-10TH.



121.
SCALE ABOUT 1-9TH.

THERMOMETER SCREENS.

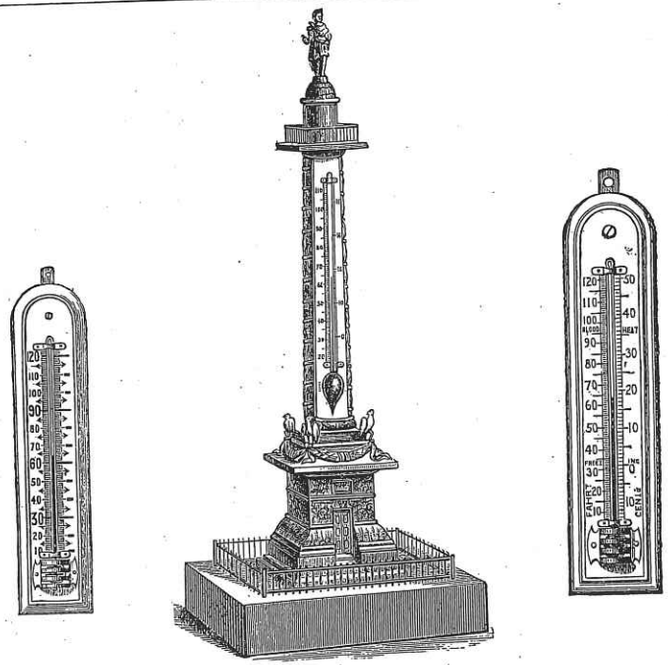
These should be so made and placed as to afford perfect shelter from the sun's direct rays, also from rain and snow, while the air, uninfluenced by radiation from walls or ground, can circulate freely round the instruments they contain.

312. **Board of Trade Thermometer Screen.**—Fig. 121 shows a form of screen much used for protecting the dry and wet bulb Thermometers on board ship and at land stations. It should be placed facing the north, at a distance of four feet from the ground. Being recommended by the Board of Trade, for marine service, it is distinguished by that name. £0 12 6

313. **Glaisher's Revolving Thermometer Stand**, for protecting the instruments from direct sun-rays in any position . . £3 0 0

314. **Stephenson's Thermometer Screen** (Fig. 120) is a rectangular chamber capable of holding, in positions convenient for observation, four or more Thermometers, one each Maximum and Minimum being suspended horizontally, while the other two are placed vertically, side by side, to act as a MASON'S Hygrometer. To ensure the free ingress and egress of air, and the exclusion of direct sun's rays, snow and rain, the four sides are double-louvred, and the bottom perforated throughout with half-inch holes; the roof, also, admits of the free exit of air. When reading the instruments, the front is allowed to fall, and is retained in a horizontal position by two strong chains. £2 0 0

315. **Professor Wild's Metallic Screen for Thermometers.**—This is described by Professor WILD, in his Report to the Meteorological Congress, at Vienna, as being made of thin sheet zinc, open below, and barely enclosed above by a conical roof. In order to ensure the free access of air to the Thermometers, and to prevent its stagnation in the screen, the sides are not only louvred, but are in segments, which overlap each other, one side only being fitted up as a door, as in Fig. 120. The advantage claimed by Professor WILD for metal over wood, is that the thin sheet of metal places itself sooner in *thermic* equilibrium with the surrounding air, and is, therefore, better adapted to prevent radiation. from £4 4 0 to £7 7 0

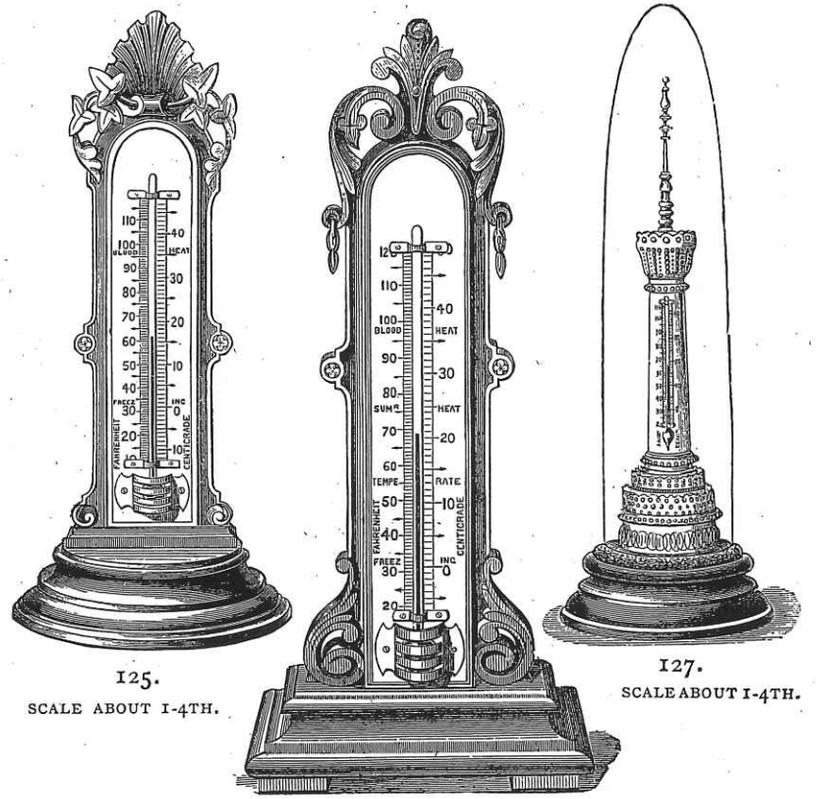


122. 123. 124.

SCALE ABOUT 1-6TH.

DRAWING ROOM THERMOMETERS.

	£	s.	d.
316. **Pedestal Drawing Room Thermometers** in solid ivory, handsomely carved and engine turned, 10-in. .	2	15	0
317. **Pedestal Drawing Room Thermometers,** in solid ivory, simpler pattern, 10-in.	1	15	0
318. **Pedestal Drawing Room Thermometers,** with compass at top, 8-in. 30/- to	1	15	0
319. **Pedestal Thermometers** on ivory scales, covered with glass shades, 4-in., 8/6; 5-in., 9/6; 6-in., 10/6; 7-in., 11/6; 8-in., 12/6; 9-in.	0	13	6
320. **Pedestal Thermometers,** in carved oak or walnut, with enamelled glass scales in front, various, 8-in., 15/6; 10-in., 17/6; 12-in.	1	1	0
321. **Pedestal Thermometers,** in real bronze, reproducing TRAJAN'S Column, Column Vendôme (Fig. 123), Column of July, Obelisk of Luxor, 7-in., 18/6 to 25/-; 9-in., 25/- to 35/-; 11-in., 35/- to 45/-; 12-in., 40/- to 50/-; 14-in. 50/- to .	3	5	0
322. **Drawing Room Thermometers,** enamel glass scales on ebony or boxwood backs, very bold and handsome, 6-in., 7/6; 8-in., 8/6; 10-in., 10/6; 12-in., 15/-; 16-in. .	1	1	0
323. **Drawing Room Thermometers,** transparent ivory scales on boxwood or ebony backs, German silver or gilded metal mounts, as preferred. 6-in., 8/6; 8-in., 9/6; 10-in., 12/6; 12-in.	0	17	6
324. **Drawing Room Thermometers,** in polished boxwood, bevelled edges, handsomely mounted, 8-in., 5/-; 10-in., 6/6; 12-in.	0	10	0



125. SCALE ABOUT 1-4TH.

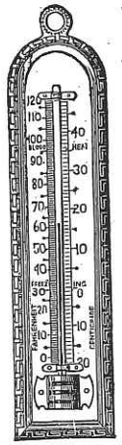
127. SCALE ABOUT 1-4TH.

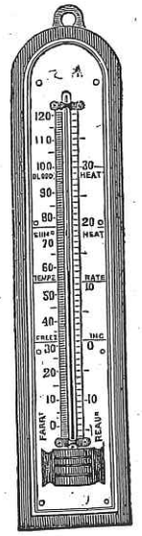
120.

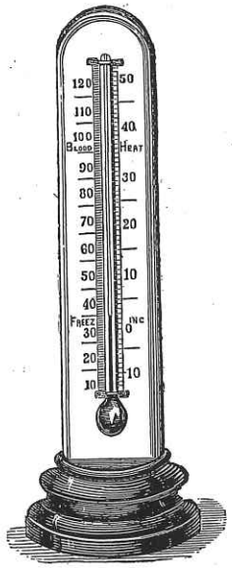
SCALE ABOUT 1-4TH.

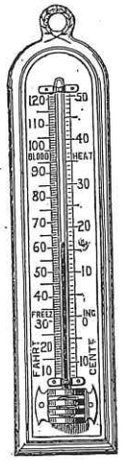
DRAWING-ROOM THERMOMETERS.

	£	s.	d.
325. **Pedestal Thermometers,** carved oak or walnut, with opal glass scale (Fig. 125), 18/6; (Fig. 126) . .	1	5	0
326. **Pedestal Thermometer,** carved ivory (Fig. 127) .	3	0	0
327. **Pedestal Thermometer,** ivory scale, ebony base, (Fig. 130)	0	13	6
328. **Drawing-Room Thermometer,** ivory scale, on ebony back (Fig. 129)	0	13	6
329. **Drawing-Room Thermometer,** ivory scale, on malachite or walnut, papier maché backs, 8-in. . .	0	7	6
330. **Mercurial Thermometer,** 8-in. porcelain tinted, in imitation of ivory with ornamented sides, FAHRENHEIT and Centigrade scales, enamel tube, metal guards, hand-divided and figured on scale	0	8	6
331. **Mercurial Thermometer,** same as preceding, 9-in., 9/6; 11-in., 10/6; 14-in. (Fig. 128)	0	12	6
332. **Spirit Thermometer,** 8-in. FAHRENHEIT and Centigrade scales, enamel tube, metal guards and mounts, hand-divided and figured on scale	0	7	6
333. **Spirit Thermometer,** same as preceding, 9-in., 8/6; 11-in. 9/6; 14-in. (like Fig. 128)	0	11	6


128.


129.


130.

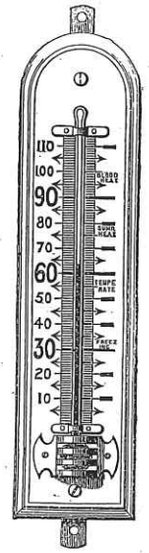

131.

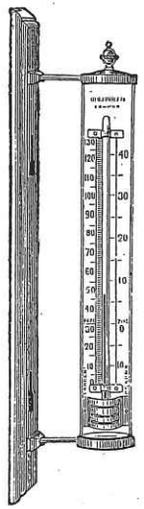

132.

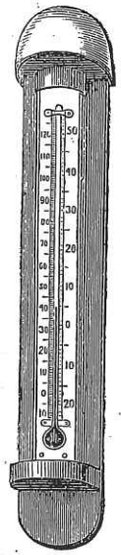
Scale about 1-5th.

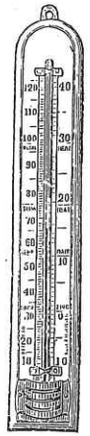
PORCELAIN THERMOMETERS.

	£	s.	d.
334. **Mercurial Thermometer,** 8-in. narrow printed Fahrenheit scale, enamel tube	0	3	6
335. **Mercurial Thermometer,** 8-in. bevelled printed Fahrenheit scale, enamel tube	0	4	0
336. **Mercurial Thermometer,** 8-in. bevelled printed Fahrenheit and Centigrade scales, enamel tube	0	4	6
337. **Mercurial Thermometer,** 8-in. printed double scales, moulded sides and metal guards, enamel tube	0	5	0
338. **Mercurial Thermometer,** 8-in. double scales, metal guards, enamel tube, hand-divided and figured on scale	0	7	6
339. **Mercurial Thermometer,** same as preceding, 9-in., 8/6; 10-in., 8/6; 11-in., 9/6; 12-in., 10/6 (Fig. 124); 14-in., 11/6 (Fig. 131); 16-in., 17/6; 20-in.	1	5	0
340. **Spirit Thermometer,** 8-in. bevelled printed Fahrenheit scale, enamel tube	0	3	6
341. **Spirit Thermometer,** 8-in. bevelled printed Fahrenheit and Centigrade scale, enamel tube	0	4	0
342. **Spirit Thermometer,** 8-in. printed Fahrenheit and Centigrade, or Fahrenheit and Reaumur scales, moulded sides and metal guards, enamel tube	0	5	0
343. **Spirit Thermometer,** legible Fahrenheit, Centigrade or Reaumur scale (Fig. 132), every thirty degrees indicated by bolder figures and broader lines, moulded sides and metal guards, enamel tube, hand-divided and figured on scale, 8-in.	0	7	0
344. **Spirit Thermometer,** same as preceding (Fig. 122), 9-in., 8/-; 10-in., 8/-; 11-in., 9/-; 12-in., 10/-; 14-in., 10/6; 16-in., 17/-; 20-in. (Fig. 133).	1	3	6


133.


134.

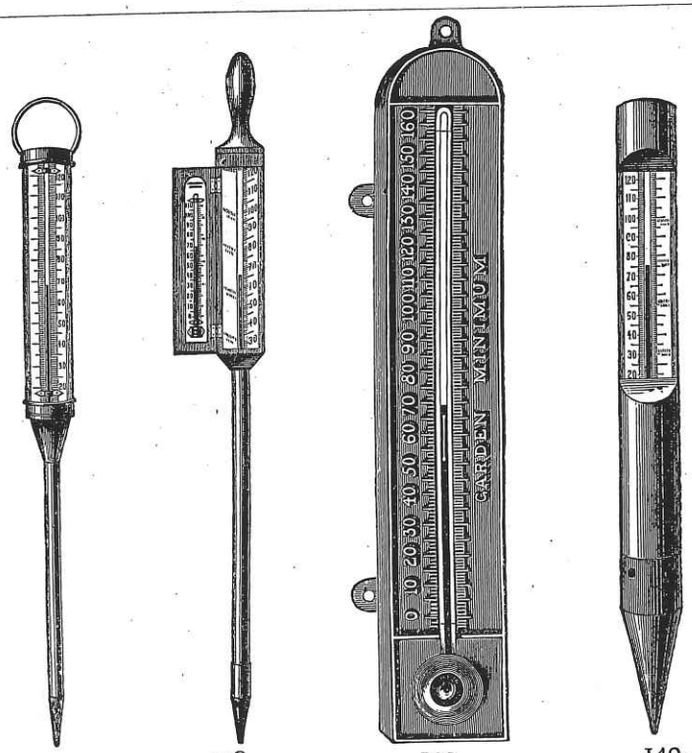

135.


136.

Scale about 1-5th.

WINDOW THERMOMETERS.

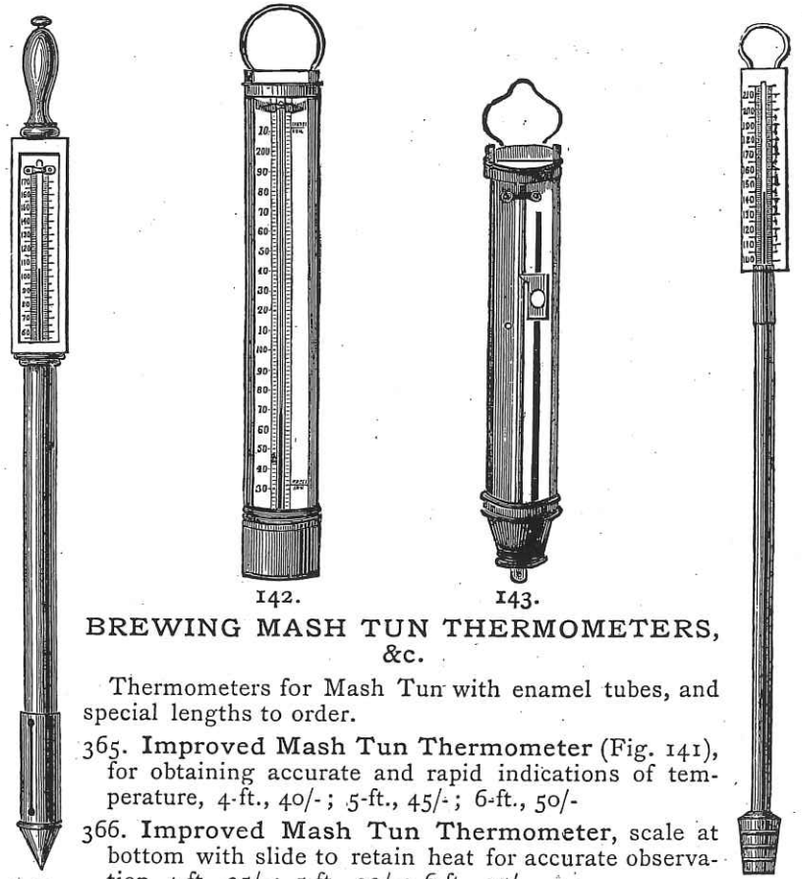
	£	s.	d.
345. **Window Thermometer,** 10-in., on glass or porcelain scale, with brackets, on oak board to revolve (Fig. 134)	0	18	6
346. **Window Thermometer,** 12-in., very bold, on glass or porcelain scale, same as preceding	1	2	6
347. **Window Thermometer** with ivory scale enclosed in glass tube, on mahogany frame, with copper roof, 8-in., 16/6; 10-in. (Fig. 135)	1	1	0
348. **Window Thermometer** with ivory scale enclosed in glass tube, on mahogany frame, with japanned roof, 8-in., 15/-; 10-in. (like Fig. 135)	0	16	6
349. **Window Thermometer** (Six's self-registering), on porcelain or opal glass scale, showing past heat and cold and temperature at the time of observation, on oak board with brackets revolving to any angle of light: 10-in., 25/-; 12-in., 30/-; 14-in., 32/6; 16-in., 35/-; 20-in., (Fig. 105)	2	5	0
350. **Window Thermometer,** 10-in. opal glass scale, on oak board, adjustable at any angle	0	8	6
351. **Window Thermometer,** 10-in., on opal glass scale, in glass cylinder, on oak board to revolve	0	10	6
352. **Cottage Window Thermometer,** 8-in. boxwood scale, adjustable and for general use	0	5	0
353. **Cottage Window Thermometer,** same as preceding, with Fahrenheit and Centigrade scales	0	7	0



137. 138. 139. 140.

GARDEN THERMOMETERS.

	£	s.	d.
354. **Garden Minimum Thermometer**, solid zinc scale, raised figures and divisions (Fig. 139)	0	3	0
355. **Garden Minimum Thermometer**, 8-in. polished boxwood scale, plain tube, double degrees	0	1	0
356. **Garden Minimum Thermometer**, 8-in. polished boxwood scale, enamel tube, double degrees	0	1	3
357. **Garden Minimum Thermometer**, 8-in. polished boxwood scale, enamel tube, single degrees	0	2	0
358. **Garden Minimum Thermometer**, 10-in. polished boxwood scale, enamel tube, double degrees	0	2	6
359. **Garden Minimum Thermometer**. 10-in polished boxwood scale, enamel tube, single degrees	0	3	0
360. **Garden Minimum Thermometer**, 12-in., bold enamel tube and bulb bent down, on polished boxwood scale, single degrees	0	4	6
361. **Hot-Bed Thermometer**, plain mounting (Fig. 140), 12-in., 5/- ; 16-in.	0	7	0
362. **Hot Bed Thermometer**, 30-in. porcelain scale, in copper case with brass tube (Fig. 137)	0	15	0
363. **Hot-Bed Thermometer**, 30-in. mahogany frame, enclosed in brass tube	1	2	6
364. **Hot-Bed Thermometer**, 30-in. mahogany frame, enclosed in brass tube, Thermometer on door for air temperature (Fig. 138)	1	7	6



141. 142. 143. 144.

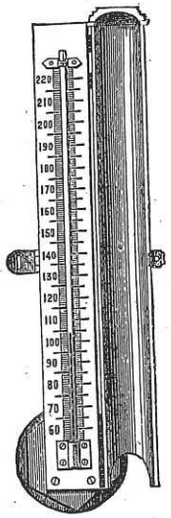
BREWING MASH TUN THERMOMETERS, &c.

Thermometers for Mash Tun with enamel tubes, and special lengths to order.

365. **Improved Mash Tun Thermometer** (Fig. 141), for obtaining accurate and rapid indications of temperature, 4-ft., 40/- ; 5-ft., 45/- ; 6-ft., 50/-

366. **Improved Mash Tun Thermometer**, scale at bottom with slide to retain heat for accurate observation, 4-ft., 25/- ; 5-ft., 30/- ; 6-ft., 35/-

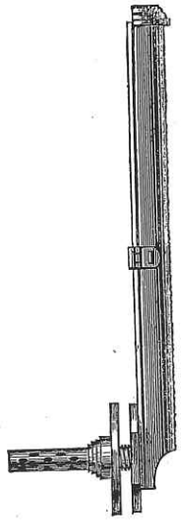
	£	s.	d.
367. **Improved Mash Tun Thermometer**, all brass, (Fig. 144), 4-ft., 40/- ; 5-ft., 45/- ; 6-ft.	2	10	0
368. **Fermenting Tun Thermometer**, incorrodible porcelain scale, enamel tube graduated from 30° to 120°, large figures, in rivetted copper case, 14-in.	0	13	6
369. **Blind Scale Thermometer**, enamel tube with sliding brass index and ivory scale to 220°, in rivetted copper case, 8-in., 10/6 ; 10-in., 11/6 ; 12-in., 12/6 ; 14-in. (Fig. 143)	0	13	6
370. **Blind Scale Thermometer**, enamel tube with ivory blind scale, in copper case, 8-in., 7/6 ; 10-in., 8/6 ; 12-in., 10/6 ; 14-in.	0	11	6
371. **Metal Scale Thermometer**, enamel tube to 120°, in copper case, 8-in., 4/6 ; 10-in., 6/6 ; 12-in., 7/6 ; 14-in.	0	8	6
372. **Metal Scale Thermometer**, same as preceding, in japanned tin case, 8-in., 3/- ; 10-in., 3/6 ; 12-in., 5/- ; 14-in.	0	6	6



145.



146.



147.

SCALE ABOUT 1-5TH.

BENT TUBE AND BATH THERMOMETERS.

	£	s.	d
373. **Bent Thermometer,** enamel tube on metal, to show (on the outside) temperature of inside of tuns, backs, &c., with sliding cover	1	15	0
374. **Bent Thermometer,** same as preceding, door to shut, extra stout (Figs. 145 and 147)	2	0	0
375. **Bent Thermometer,** solid elbow bend, dome top, revolving cover (Fig. 146)	2	15	0
376. **Fermenting and Cooling Tun Thermometer,** enamel tube on metal or porcelain scale, on mahogany frame, with door to lock, 4-ft., 35/-; 5-ft., 38/-; 6-ft.	2	2	0
377. **Fermenting and Cooling Tun Thermometer,** as preceding, without door, 4-ft., 27/6; 5-ft., 30/-; 6-ft.	1	17	6
378. **Pipe Thermometer,** enamel tube, on metal or porcelain scale, revolving cover, with cup to solder to pipe	1	15	0
379. **Pipe Thermometer,** same as preceding, without revolving cover, with cup to solder to pipe	1	8	6

BATH THERMOMETERS.

380. **Bath Thermometer,** 8-in. printed porcelain scale, plain tube, black japanned case, 3/-; white japanned case, 3/6; copper case	0	4	0
381. **Bath Thermometer,** 8-in. ditto enamel tube, black japanned case, 3/6; white japanned case, 4/-; copper case	0	4	6

It is necssary, in ordering, to state diameter of pipe for which the Thermometer is intended, and length of bend required.

BOXWOOD SCALE THERMOMETERS.

Description.	EACH. 8-in.	10-in.	12-in.
382. **Spirit Thermometer,** round top, plain tube	-/10	1/4	2/-
383. **Spirit Thermometer,** polished do., do.	1/-	1/6	2/3
384. **Spirit Thermometer,** do., enamel tube	1/3	1/9	2/6
385. **Spirit Thermometer,** polished do., do.	1/6	2/-	3/-
386. **Spirit Thermometer,** do., better quality	1/9	2/6	3/6
387. **Spirit Thermometer,** polished do., do.	2/-	2/9	4/-
388. **Spirit Thermometer,** do. do., FAHRENHEIT and Centigrade scales	2/3	3/-	4/6
389. **Spirit Thermometer,** do., bevelled edge, round or eliptic top, enamel tube, FAHR. scale	2/3	3/-	5/-
390. **Spirit Thermometer,** do., as preceding, FAHR. and Cent. scales (Fig. 136)	2/6	3/6	5/6
391. **Spirit Thermometer,** polished, round or eliptic top, bevelled edge, enamel tube, FAHRENHEIT and Centigrade scales, gilding, metal or German silver mounts	3/6	5/6	8/-
392. **Mercurial Thermometer** (as 382)	-/10	1/4	2/-
393. **Mercurial Thermometer** (as 383)	1/-	1/6	2/6
394. **Mercurial Thermometer** (as 384)	1/3	2/-	3/6
395. **Mercurial Thermometer** (as 385)	1/6	2/6	4/-
396. **Mercurial Thermometer** (as 386)	1/9	2/9	4/6
397. **Mercurial Thermometer** (as 387)	2/-	3/6	5/-
398. **Mercurial Thermometer** (as 388)	2/6	4/-	5/6
399. **Mercurial Thermometer** (as 389)	2/6	4/-	5/6
400. **Mercurial Thermometer** (as 390)	3/-	4/6	6/-
401. **Mercurial Thermometer** (as 391)	4/-	5/6	9/-

BREWERS' THERMOMETERS.

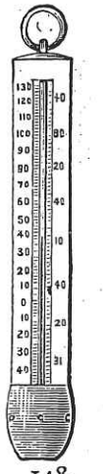
Description.		1. Each.	2. Each.	3. Each.
402. Metal scale, plain tube, japan case 8-in.		2/-	2/3	2/6
403. Do. do. do. 10-in.		2/6	3/-	3/6
404. Do. do. do. 12-in.		3/6	4/-	4/6
405. Do. do. do. 14-in.		4/-	4/6	5/-
406. Do. do., copper case, 8-in.		3/6	4/-	4/6
407. Do. do. do. 10-in.		4/-	4/-6	5/-
408. Do. do. do. 12-in.		5/-	5/6	6/-
409. Do. do. do. 14-in.		5/6	6/-	6/6
410. Do., enamel tube, japan case 8-in.		2/6	3/-	3/6
411. Do. do. do. 10-in.		3/-	3/6	4/-
412. Do. do. do. 12-in.		4/-	4/6	5/-
413. Do. do. do. 14-in.		4/6	5/-	5/6
414. Do. do., copper case, 8-in.		4/-	4/6	5/-
415. Do. do. do. 10-in.		4/6	5/-	5/6
416. Do. do. do. 12-in.		5/6	6/-	6/6
417. Do. (Fig. 142) do. 14-in.		6/-	6/6	7/-

BREWERS' THERMOMETERS—(CONTINUED).

	8-in.	10-in.	12-in.	14-in.
	Each.	Each.	Each.	Each.
418. Porcelain scale, enamel tube, copper case	5/6	6/6	8/-	9/-
419. Do. do., japanned case	4/6	5/6	7/-	7/6
420. Do., plain tube, copper case	5/-	6/-	7/6	8/-
421. Do. do. japanned case	4/-	5/-	6/-	7/-

PORTABLE POCKET THERMOMETERS.

	£	s.	d.
422. **Ivory Thermometers,** enamel tube, double scale, morocco case, 3-in., 5/6; 4-in., 6/-; 5-in., 6/6; 6-in.	0	7	6
423. **Ivory Thermometers,** same as preceding, in snap morocco cases, 3-in., 6/-; 4-in., 6/6; 5-in., 7/-; 6-in.	0	8	0
424. **German Silver Revolving Thermometers,** enamel tube, ivory scale, on boxwood or ebony back, 3-in., 7/6; 3½-in., 8/6; 4-in., 9/6; 4½-in. (Fig. 152)	0	10	0
425. **Sliding-lid Thermometers,** enamel tube, with ivory or metal scales, in sandal, mahogany, walnut or rosewood cases, 4-in., 7/6; 5-in., 8/6; 6-in., 9/6; 7-in., 10/6; 8-in.	0	11	6
426. **Beehive Thermometers,** oval shape enamel tube, double scale, boxwood, 7/6; white ivory, 10/6; transparent do	0	11	6
427. **Beehive Thermometers,** round shape, to unscrew (Fig. 148), boxwood, 3-in., 4/-; 4-in., 5/-; ivory, 3-in., 7/6; 4-in.	0	8	6
428. **Thermometers,** divided and figured on stem, in round ivory case to unscrew, 4-in., 7/6; 5-in., 8/6; 6-in.	0	9	6
429. **Thermometers,** same as preceding, in polished boxwood or ebony cases, 4-in., 6/6; 5-in., 7/6; 6-in.	0	8	6
430. **Maximum and Minimum Thermometers** for Alpine tourists, 6-in. enamel tubes, engine-divided on stem, figured on raised German silver scale, on boxwood, in mahogany snap case (Fig. 108)	1	10	0
431. **Maximum and Minimum Thermometers,** enamel tubes, sunk into boxwood scales, engine-divided on stem and fiured on scale, 8-in., in morocco case	1	1	0
432. **Maximum and Minimum Thermometers,** as preceding, not divided on the stem, 8-in., in morocco case	0	18	6
433. **Maximum and Minimum Thermometers,** enamel tubes, engine-divided, figured on scale, 8-in., morocco case	1	0	0
434. **Maximum and Minimum Thermometers,** as preceding, not divided on the stem, 8-in., in morocco case	0	17	6
435. **Maximum and Minimum Thermometers** (LIVINGSTONE'S), very portable, divided on the stem, on metal scales, in mahogany or morocco case (Fig. 119)	1	10	0
436. **Mason's Hygrometer,** enamel tubes, engine-divided on stem, figured on German silver scales, very compact, with stand and water cistern, in mahogany case (Fig. 165)	1	15	0
437. **Portable Wet and Dry Bulb Thermometers,** or Mason's Hygrometer, 6-in. upright metal scales, brass foot and stand, in mahogany case	1	15	0



148.



149.



150.



151.

CHEMICAL AND OVEN THERMOMETERS.

438. **Chemical Thermometer,** enamel tube, hinged boxwood scale, (Fig. 149) divided to—

	8-in.	10-in.	12-in.	14-in.	16-in.	18-in.
0° to 220°	6/6	7/6	8/6	9/-	10/6	11/6
0° to 400°	7/6	8/6	9/6	10/-	11/6	12/6
0° to 650°	8/6	9/6	10/6	11/6	12/6	13/6

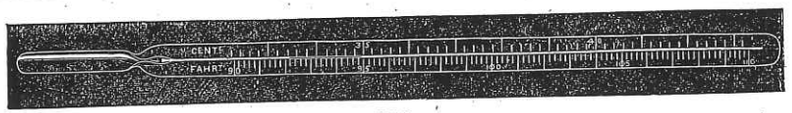
439. **Chemical Thermometers,** same as preceding, but with plain tubes, 1/- each less.

440. **Chemical Thermometers,** divided and figured on stem, enamel tube, in round wooden case (Fig. 150)

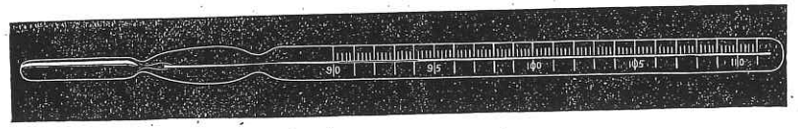
	8-in.	10-in.	12-in.	14-in.	16-in.	18-in.
0° to 220°	5/6	6/-	7/-	7/6	8/-	9/6
0° to 400°	6/-	6/6	7/6	8/-	8/6	10/-
0° to 650°	6/6	7/-	8/-	8/6	9/-	10/6

441. **Chemical Thermometers,** same as preceding, but with plain tubes, 9d. each less.

	£	s.	d.
442. **Chemical Thermometers,** insulated with paper scales to 212°, 2/6; to 350°, 3/6; to 600°	0	4	6
443. **Chemical Thermometers,** insulated with milk glass scale to 212°, 4/6; to 350°, 5/6; to 600°	0	6	6
444. **Oven Thermometer** (self-registering), to indicate the temperature of various parts of an oven	1	1	0
445. **Oven Thermometer,** on cast iron foot, graduated from 60° to 500°, with baking heats marked on the scale	1	5	0



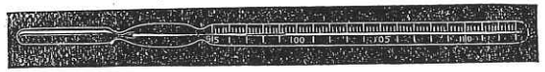
152.
SCALE ABOUT 2-3RDS.
6-IN. DOUBLE SCALE.



153.
SCALE ABOUT 2-3RDS.
6-IN. PATENT CONSTRICTED TUBE.



154.
SCALE ABOUT 2-3RDS.
4-IN. SINGLE SCALE.



155.
SCALE ABOUT 2-3RDS.
4-IN. PATENT CONSTRICTED TUBE.

CLINICAL THERMOMETERS.

(Dr. AITKEN'S principle.*)

The normal temperature of the human body, at completely sheltered parts of its surface, amounts to 98·4° FAHR., or a *few tenths* more or less; and a rising above 99·5° FAHR., or a depression below 97·3° FAHR., are sure signs of some kind of disease, *if such increase or depression is persistent.*

The average temperature of the trunk of the body in the Tropics is nearly *one degree* higher than in temperate regions.

The increase of temperature above 99° FAHR., *as measured by the Thermometer*, is *the best index* of the amount of fever present in any disease.

The temperature of the body in disease is much more readily and rapidly influenced than either the pulse or the respiration.

The co-relation of the pulse, respiration and temperature, is of the utmost importance to be known in many diseases. For example, in *pneumonia*, if the mean of the temperature is not above 104° FAHR., and that of the pulse is not above 120 in a minute, and the mean of the respirations not over 40 in the same time, the case must be considered a slight one; and, if the patient is otherwise healthy, he will surely begin to get well in from eight to twelve days, without any medical treatment beyond attention to diet and rest.

Each disease which runs a definite course *(e.g., scarlet fever, measles, small-pox, typhus fever, typhoid fever, rheumatism, acute phthisis,* and the like) has a characteristic and distinctive range of temperature.

* See AITKEN'S "Science and Practice of Medicine," 2 vols. 8vo.



156.
SCALE ABOUT 2-3RDS.
5-IN. SINGLE SCALE.



157.
SCALE ABOUT 2-3RDS.
5-IN. PATENT CONSTRICTED TUBE.



158.
SCALE ABOUT 2-3RDS.
3½-IN. SINGLE SCALE.

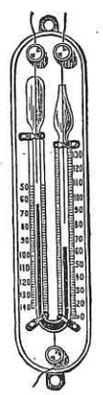


159.
SCALE ABOUT 2-3RDS.
3½-IN. PATENT CONSTRICTED TUBE.

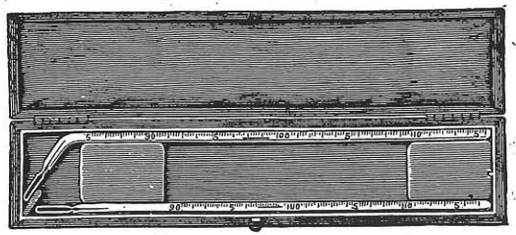
CLINICAL THERMOMETERS (SELF-REGISTERING),

(WITH OR WITHOUT THE PATENT CONSTRICTION).

	£	s.	d.
446. **Clinical Thermometer** (3½-in., 4-in., 5-in., and 6-in.) in lined boxwood or ebony case (Fig. 163) . . .	0	6	6
447. **Clinical Thermometer,** in German silver case .	0	7	0
448. **Clinical Thermometer,** in ivory case . 7/6 to	0	9	6
449. **Clinical Thermometer,** in ebonite case . 7/- to	0	8	6
450. **Clinical Thermometers,** oval back and front, in any of the above cases, each extra	0	1	0
451. **Clinical Thermometer** with flat back, and the front made in the form of a lens, so as to magnify the mercurial column, in any of the above cases, each extra .	0	1	0
452. **Clinical Thermometer** (8-in.), in square or round end, boxwood case	0	8	6
453. **Clinical Thermometer** (4-in.), in aluminium gold, engine-turned, or fluted case	0	8	0
434. **Clinical Thermometer** (5-in.), do. do. do.	0	8	6
455. **Clinical Thermometer** (3½-in.), silver case . .	0	10	0
456. **Clinical Thermometer** (4-in.), silver case . .	0	10	6
457. **Clinical Thermometer**(3½-in. or 4-in.), plated silver case	0	7	6
458. **Clinical Thermometer** (3½-in., 4-in., or 5-in.), in Dr. HILLIARD'S round sliding pocket case, silver plated .	0	11	6
459. **Clinical Thermometer** (4-in.), in Dr. HILLIARD'S oval sliding pocket case, silver plated	0	12	6
460. **Clinical Thermometer** (4-in.), aluminium gold case, engine-turned or fluted, spirally propelled . . .	0	12	6
461. **Clinical Thermometer** (4-in.), MAYER & MELTZER'S case, silver plated case, spirally propelled . . .	0	12	6



160.

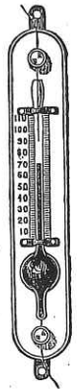


162.

SCALE ABOUT 1-4TH.



163.



161.



164.

SCALE ABOUT 1-3RD.

CLINICAL THERMOMETERS.

	£	s.	d.
462. **Clinical Thermometer,** self-registering (7-in.), bent in morocco case	0	8	6
463. **Clinical Thermometer,** non-registering (7-in.) bent, in morocco case	0	8	0
464. **Set of 7-inch Clinical Thermometers** in snap morocco case, consisting of one bent, non-registering, and one straight registering Thermometer (Fig. 162)	0	13	6
465. **Set of 9-inch Clinical Thermometers,** in snap morocco case, same as above	0	15	6
466. **Set of 12-inch Clinical Thermometers,** in morocco or mahogany case, consisting of one bent, non-registering, and one straight registering Thermometer	0	18	6
467. **Veterinary Clinical Self-registering Thermometer,** open scale and protecting German silver shield, arranged for treatment of cattle, 10-in. (Fig. 164)	0	12	6
468. **Dr. Aitken's Clinical Chart of Temperature, Pulse, Respiration and Excreta,** arranged for 31 days, with scale of FAHR. and Centigrade degrees, per doz.	0	1	0
469. **Guy's Hospital Chart** per dozen	0	1	0
470. **Electric Thermometers,** with single tube (Fig. 160) platinum wires and binding screws, divided and figured on boxwood scale, 7-in., 11/6; 9-in.	0	12	6
471. **Electric Thermometers,** with double tubes (Fig. 161) platinum wires and binding screws, for registering heat and cold, 7-in., 13/6; 9-in.	0	15	6
472. **Electric Thermometers,** same as No. 470, on porcelain scales to 500° FAHR., for dentists, ovens, &c., 7-in., 13/6; 9.in.	0	15	6

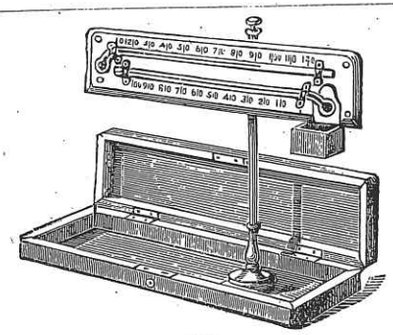
Where FAHRENHEIT and Centigrade, or FAHRENHEIT and REAUMUR, or Centigrade and REAUMUR scales are required on one instrument, the price will be 2/6 extra (see Fig. 152).

PYROMETERS.

The Pyrometer is an instrument for estimating temperatures beyond the range of ordinary Thermometers. With one exception (WEDGWOOD'S Porcelain Contraction Pyrometer) the degrees of the scales are continuations of the FAHRENHEIT Scale.

The indications of a mercurial Thermometer are not regarded as trustworthy beyond 640°. When, therefore, it is desired to measure much higher temperatures, recourse may be had to the ingenious invention known as the Pyrometer, of which there are several varieties.

	£	s.	d.
473. **Wedgwood's Pyrometer,** founded on the property which clay possesses, of contracting when heated, consists of two graduated horizontal metallic scales secured to a rectangular base and inclined at a very slight angle to each other. Small sections, of uniform length, from a plano-convex cylinder of clay are made and baked at a dull red heat, and when it is desired to ascertain the heat of a furnace, one of these pellets is placed therein until it acquires the glowing heat apparent at the time; it is then expeditiously withdrawn, placed between the two scales, and pushed as far as it will go: the point at which it rests indicates the temperature	5	5	0
474. **Daniell's Pyrometer** is founded on the expansion of a bar of platinum, or iron, enclosed in a tube of graphite, which also encloses (in contact with the metallic bar) a rod of porcelain, extending beyond the furnace and pressing against the shorter arm of a lever. As the expansion takes place, this moves a vernier on the longer arm, traversing a scale so divided as to indicate degrees of FAHRENHEIT'S Thermometer	5	5	0
475. **Ferguson's Pyrometer** is an experimental apparatus used by lecturers, for showing the different degrees of expansibility in metals	5	5	0
476. **Gauntlett's Pyrometer** resembles an Aneroid Barometer, with a tube about 5-feet long and 7-8th's in diameter attached to it. The scale on the dial is divided to 300° for fluids, or to 1000° for furnaces, ovens, &c. It is constructed of bars of metal, which expand in varying degrees as the temperature rises, and these, pressing on the index needle, show temperatures beyond the mercurial Thermometer range on the circular scale referred to	4	4	0
477. **Gauntlett's Chronometrical Pyrometer.** This is a recording instrument with eight-day time-piece, &c., to indicate to 300° or 1000°	8	10	0
478. **Byström's Hydro-Pyrometer** indicates high temperatures by the number of degrees a given weight of pure water is raised, on dexterously immersing a ball of platinum after it has acquired the temperature of the furnace or oven to be tested. A set of Pyrometer Tables is furnished with this instrument. Made to order			



165.

SCALE ABOUT

HYGROMETERS.

These instruments are employed for estimating the amount of moisture in the air. In our climate the air is never completely dry, nor completely saturated with moisture, and the amount of aqueous vapour held in suspension is very variable. This fact has important bearings on many branches of industry, as also on the hygienic qualities of the atmosphere. The consideration that a certain amount of moisture in the air is necessary to the continuance of health, will suggest the importance of maintaining that due proportion in the atmosphere of sick rooms, where the artificial heat so injudiciously used, often disturbs the healthful hygrometric condition of the air. Mr. GLAISHER is of opinion that the medical profession should enforce, as far as lies in their power, the use of this simple and effective instrument, which gives indications so important to the comfort of the patient.

Hygrometers may be thus classified:—

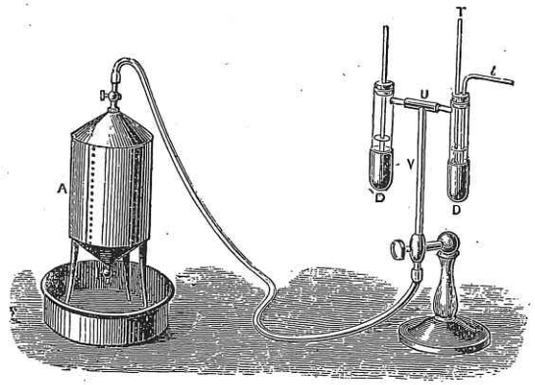
1. Hygrometers of Absorption.—SAUSSURE'S Hair, Oatbeard, Catgut, Seaweed, Grass, Chloride of Calcium.
2. Hygrometers of Condensation.—REGNAULT'S, DANIELL'S, DYNE'S.
3. Hygrometers of Evaporation.—LESLIE'S, MASON'S Hygrometer, Wet and Dry Bulb Thermometer or Psychrometer.

479. **Oatbeard Hygrometer**, strongly gilt, in morocco case, for testing the amount of moisture in beds, apartments, &c. 0 10 6

480. **Damp Detectors**, for Tourists, Commercial Travellers, &c., to test moisture and avoid the consequences of sleeping in damp beds. Brass mounting, in morocco case (Fig. 169) 0 7 6

481. **Saussure's Hygrometer.**—The frame is of brass and the scale of the same metal silvered. It has an attached Thermometer, and the indications are the result of the contraction and expansion of a prepared human hair, consequent upon its absorbing or yielding moisture. The scale is divided on the arc of a circle, and an index needle, working on an eccentric pivot, multiplies the indications 2 2 0

482. **Dyne's Hygrometer**, for showing the dew-point by direct observation, by means of iced water and black glass. This arrangement enables the observer to dispense with the use of ether, and shows the dew-point with great distinctness 1 10 0

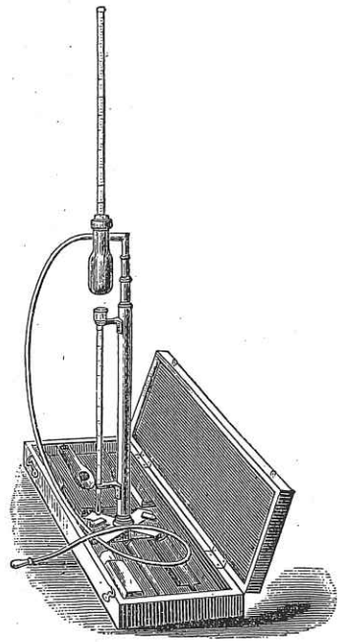


166.

SCALE ABOUT 1-12TH.

REGNAULT'S HYGROMETERS.

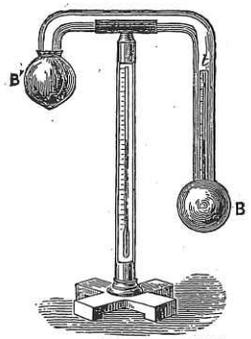
483. **Regnault's Hygrometer** (Fig. 167) acts like DANIELL'S, by the condensation of moisture on its external surface, and possesses some important advantages over the former instrument. It consists of a very thin and highly polished silver tube or bottle, into the neck of which is inserted a very delicate Thermometer. The bottle has a lateral tubular opening, to which is attached a flexible tube with an ivory mouthpiece. Ether is poured into the silver tube in sufficient quantity to cover the bulb of the Thermometer. The ether is then agitated by breathing through the flexible tube until, by the rapid evaporation thus produced, a condensation of moisture takes place, readily observable on the bright polished silver surface, and the temperature indicated by the Thermometer at that moment is the dew-point. Complete in case £3 10 0



167.

SCALE ABOUT 1-10TH.

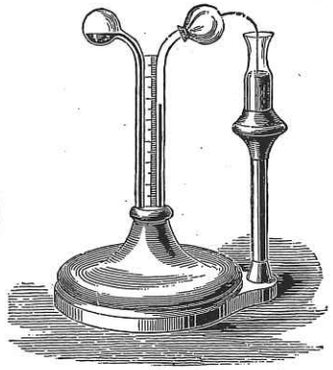
484. **Regnault's Hygrometer, with Aspirator** (Fig. 166). An exceedingly thin silver cup (D), highly polished on the outside, is cemented to a tube of glass (M), the mouth of which is closed by a cork having three openings. The central opening receives the stem of a Thermometer (T), while one of the side openings is filled by the tube (b) communicating with the outer air. In the third opening a tube (V) is adapted, connected by a caoutchouc tube with the aspirator (A), which is full of water and placed at some distance from the Hygrometer; this tube (V) only just enters the tube, while the tube (b) passes



DANIELL'S HYGROMETER.
168.
SCALE ABOUT 1-5TH.



DAMP DETECTOR.
169.
SCALE ABOUT 2-3RDS.



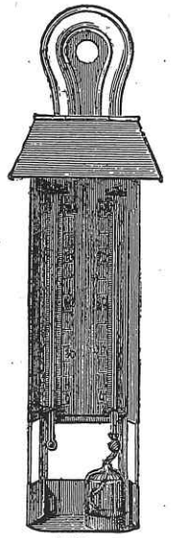
LESLIE'S HYGROMETER.
170.
SCALE ABOUT 1-6TH.

HYGROMETERS.

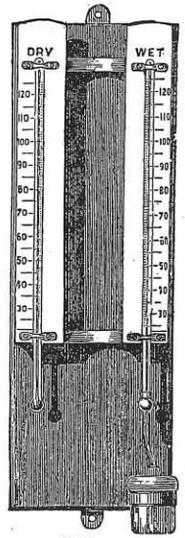
to the bottom. After having filled the silver cup with ether, so as to cover the thermometer bulb, the operator places himself near the aspirator and behind a magnifying glass, or small telescope, which enables him to follow the course of the mercurial column, and note the temperature at the exact moment when the silver becomes dull from the deposition of dew, which soon follows the rapid flow of air through the tube, induced by the flow of water from the aspirator, on opening the stopcock (R). A second apparatus, similar to the first and placed very near it, allows the operator to note the temperature when the aqueous vapour of the atmosphere begins to condense £7 7 0

485. **Daniell's Hygrometer,** or Dew-point Thermometer (Fig. 168), consists of a glass tube, bent twice at right angles, each extremity terminating in a bulb about 1¼ inches in diameter; this is supported on a brass stand, to which a Thermometer is attached to indicate the temperature of the surrounding air. The lower bulb is made of black glass to prevent radiation from within; it is about three parts filled with pure ether and contains a very delicate Thermometer. The upper bulb at the extremity of the short stem is transparent, but covered with thin muslin, upon which, when an observation is made, pure ether is slowly dropped. The evaporation rapidly lowers the temperature in the left hand bulb until a moment arrives at which dew condenses on the black bulb. A quick eye is necessary to note *this* and the temperature shown by the Thermometer *simultaneously*, the latter showing the degree at which the atmosphere is saturated with moisture *at the time of observation*. To avoid error, it is usual to note the temperature at which the dew disappears, and take the mean of the two temperatures. Complete in case, with ether bottle, £2 15 0

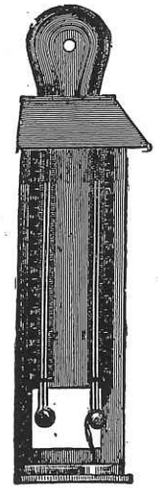
486. **Leslie's Hygrometer** (Fig. 170) consists of a tube bent syphon-fashion, and terminating at the upper extremities in two bulbs turned outward from each other. The tube is partly filled with a coloured fluid, and one bulb is covered with thin muslin kept constantly moist by some threads dipping into a vessel of water. The evaporation from this bulb will be in direct proportion to the dryness of the air; and, as the temperature varies, the liquid rises or falls in the left hand stem of the instrument. £1 1 0



171.



172.
SCALE ABOUT 1-6TH.



173.

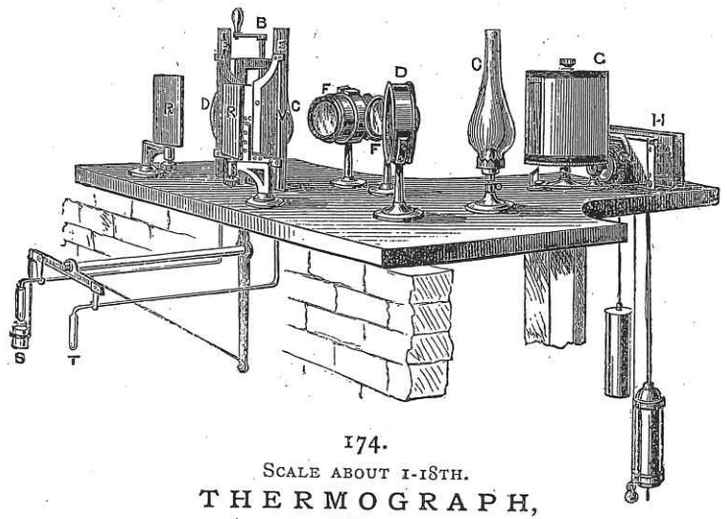
MASON'S HYGROMETERS.

	£	s.	d.
487. **Mason's Hygrometer,** best standard, incorrodible porcelain scales, on mahogany or oak board, tubes engine-divided on stem and figured on the scales, largest size (Fig. 172), very superior	1	17	6
488. **Mason's Hygrometer,** incorrodible porcelain scales, on mahogany or oak board, tubes engine-divided on stem and figured on the scales	1	12	6
489. **Mason's Hygrometer,** incorrodible porcelain scales, on mahogany or oak board, tubes engine-divided on stem and figured on the scales	1	1	0
490. **Mason's Hygrometer,** incorrodible porcelain scales, on mahogany or oak board, divided and figured on the scales	0	17	6
491. **Mason's Hygrometer,** incorrodible porcelain scale, in japanned metal case (Fig. 173)	0	15	6
492. **Mason's Hygrometer,** opal glass scale, in white japanned metal case	0	15	6
493. **Mason's Hygrometer,** slate scale, in white japanned metal case (Fig. 171)	0	15	6
494. **Mason's Hygrometer,** boxwood scale, in white japanned metal case (like Fig. 171)	0	12	6
495. **Mason's Hygrometer,** narrow boxwood scale, in white japanned case	0	10	6
496. **Portable Hygrometer,** horizontal, on brass stand, packed in mahogany case (Fig. 165)	1	15	0
497. **Pocket Hygrometer,** upright metal scales, 6-in. brass foot and stand, in mahogany case, complete	1	15	0
498. **Table of Factors,** for use with MASON'S Hygrometers	0	2	6
499. **Marriott's Hygrometer Tables*** (see page 98)	0	0	6

* Reproduced by kind permission of the Author.

MARRIOTT'S WET AND DRY BULB HYGROMETER TABLE.

Reading of Dry Thermometer.	Difference between Dry and Wet Thermometers.														
	1°0	2°0	3°0	4°0	5°0	6°0	7°0	8°0	9°0	10°0	11°0	12°0	13°0	14°0	15°0
	Amount to be subtracted from the Wet Thermometer to obtain the Dew Point.														
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
30	3·2	6·3	9·5	12·6	15·8	18·9	22·1	25·2	28·4	31·5	34·7	37·8	41·0	44·1	47·3
31	2·7	5·4	8·1	10·8	13·5	16·2	18·9	21·6	24·3	27·0	29·7	32·4	35·1	37·8	40·5
32	2·3	4·6	7·0	9·3	11·6	13·9	16·2	18·6	20·9	23·2	25·5	27·8	30·2	32·5	34·8
33	2·0	4·0	6·0	8·0	10·0	12·1	14·1	16·1	18·1	20·1	22·1	24·1	26·1	28·1	30·2
34	1·8	3·5	5·3	7·1	8·9	10·6	12·4	14·2	15·9	17·7	19·5	21·2	23·0	24·8	26·6
35	1·6	3·2	4·8	6·4	8·0	9·6	11·2	12·8	14·4	16·0	17·6	19·2	20·8	22·4	24·0
36	1·5	3·0	4·5	6·0	7·5	9·0	10·5	12·0	13·5	15·0	16·5	18·0	19·5	21·0	22·5
37	1·4	2·8	4·3	5·7	7·1	8·5	9·9	11·4	12·8	14·2	15·6	17·0	18·5	19·9	21·3
38	1·4	2·7	4·1	5·4	6·8	8·2	9·5	10·9	12·2	13·6	15·0	16·3	17·7	19·0	20·4
39	1·3	2·6	4·0	5·3	6·6	7·9	9·2	10·6	11·9	13·2	14·5	15·8	17·2	18·5	19·8
40	1·3	2·6	3·9	5·2	6·5	7·7	9·0	10·3	11·6	12·9	14·2	15·5	16·8	18·1	19·4
41	1·3	2·5	3·8	5·0	6·3	7·6	8·8	10·1	11·3	12·6	13·9	15·1	16·4	17·6	18·9
42	1·2	2·5	3·7	4·9	6·2	7·4	8·6	9·8	11·1	12·3	13·5	14·8	16·0	17·2	18·5
43	1·2	2·4	3·6	4·8	6·0	7·2	8·4	9·6	10·8	12·0	13·2	14·4	15·6	16·8	18·0
44	1·2	2·4	3·5	4·7	5·9	7·1	8·3	9·4	10·6	11·8	13·0	14·2	15·3	16·5	17·7
45	1·2	2·3	3·5	4·6	5·8	7·0	8·1	9·3	10·4	11·6	12·8	13·9	15·1	16·2	17·4
46	1·1	2·3	3·4	4·6	5·7	6·8	8·0	9·1	10·3	11·4	12·5	13·7	14·8	16·0	17·1
47	1·1	2·2	3·4	4·5	5·6	6·7	7·8	9·0	10·1	11·2	12·3	13·4	14·6	15·7	16·8
48	1·1	2·2	3·3	4·4	5·5	6·6	7·7	8·8	9·9	11·0	12·1	13·2	14·3	15·4	16·5
49	1·1	2·2	3·2	4·3	5·4	6·5	7·6	8·6	9·7	10·8	11·9	13·0	14·0	15·1	16·2
50	1·1	2·1	3·2	4·2	5·3	6·4	7·4	8·5	9·5	10·6	11·7	12·7	13·8	14·8	15·9
51	1·0	2·1	3·1	4·2	5·2	6·2	7·3	8·3	9·4	10·4	11·4	12·5	13·5	14·6	15·6
52	1·0	2·0	3·1	4·1	5·1	6·1	7·1	8·2	9·2	10·2	11·2	12·2	13·3	14·3	15·3
53	1·0	2·0	3·0	4·0	5·0	6·0	7·0	8·0	9·0	10·0	11·0	12·0	13·0	14·0	15·0
54	1·0	2·0	2·9	3·9	4·9	5·9	6·9	7·8	8·8	9·8	10·8	11·8	12·7	13·7	14·7
55	1·0	1·9	2·9	3·8	4·8	5·8	6·7	7·7	8·6	9·6	10·6	11·5	12·5	13·4	14·4
56	0·9	1·9	2·8	3·8	4·7	5·6	6·6	7·5	8·5	9·4	10·3	11·3	12·2	13·2	14·1
57	0·9	1·8	2·8	3·7	4·6	5·5	6·4	7·4	8·3	9·2	10·1	11·0	12·0	12·9	13·8
58	0·9	1·8	2·7	3·6	4·5	5·4	6·3	7·2	8·1	9·0	9·9	10·8	11·7	12·6	13·5
59	0·9	1·8	2·7	3·6	4·5	5·3	6·2	7·1	8·0	8·9	9·8	10·7	11·6	12·5	13·4
60	0·9	1·8	2·6	3·5	4·4	5·3	6·2	7·0	7·9	8·8	9·7	10·6	11·4	12·3	13·2
61	0·9	1·7	2·6	3·5	4·4	5·2	6·1	7·0	7·8	8·7	9·6	10·4	11·3	12·2	13·1
62	0·9	1·7	2·6	3·4	4·3	5·2	6·0	6·9	7·7	8·6	9·5	10·3	11·2	12·0	12·9
63	0·9	1·7	2·6	3·4	4·3	5·1	6·0	6·8	7·7	8·5	9·4	10·2	11·1	11·9	12·8
64	0·8	1·7	2·5	3·3	4·2	5·0	5·8	6·6	7·5	8·3	9·1	10·0	10·8	11·6	12·5
65	0·8	1·6	2·5	3·3	4·1	4·9	5·7	6·6	7·4	8·2	9·0	9·8	10·7	11·5	12·3
66	0·8	1·6	2·4	3·2	4·1	4·9	5·7	6·5	7·3	8·1	8·9	9·7	10·5	11·3	12·2
67	0·8	1·6	2·4	3·2	4·0	4·8	5·6	6·4	7·2	8·0	8·8	9·6	10·4	11·2	12·0
68	0·8	1·6	2·4	3·2	4·0	4·7	5·5	6·3	7·1	7·9	8·7	9·5	10·3	11·1	11·9
69	0·8	1·6	2·3	3·1	3·9	4·7	5·5	6·2	7·0	7·8	8·6	9·4	10·1	10·9	11·7
70	0·8	1·5	2·3	3·1	3·9	4·6	5·4	6·2	6·9	7·7	8·5	9·2	10·0	10·8	11·6
71	0·8	1·5	2·3	3·0	3·8	4·6	5·3	6·1	6·8	7·6	8·4	9·1	9·9	10·6	11·4
72	0·8	1·5	2·3	3·0	3·8	4·5	5·3	6·0	6·8	7·5	8·3	9·0	9·8	10·5	11·3
73	0·7	1·5	2·2	3·0	3·7	4·4	5·2	5·9	6·7	7·4	8·1	8·9	9·6	10·4	11·1
74	0·7	1·5	2·2	2·9	3·7	4·4	5·1	5·8	6·6	7·3	8·0	8·8	9·5	10·2	11·0
75	0·7	1·4	2·2	2·9	3·6	4·3	5·0	5·8	6·5	7·2	7·9	8·6	9·4	10·1	10·8
76	0·7	1·4	2·1	2·8	3·6	4·3	5·0	5·7	6·4	7·1	7·8	8·5	9·2	9·9	10·7
77	0·7	1·4	2·1	2·8	3·5	4·2	4·9	5·6	6·3	7·0	7·7	8·4	9·1	9·8	10·5
78	0·7	1·4	2·1	2·8	3·5	4·1	4·8	5·5	6·2	6·9	7·6	8·3	9·0	9·7	10·4
79	0·7	1·4	2·1	2·8	3·5	4·1	4·8	5·5	6·2	6·9	7·6	8·3	9·0	9·7	10·4



174.

SCALE ABOUT 1-18TH.

THERMOGRAPH,

AND

SELF-RECORDING HYGROMETER, £82.

As adopted by the Meteorological Committee of the Royal Society.

500. The thermometric and hygrometric records, which this instrument is designed to produce, are largely aided by photography. While, therefore, the bulbs of the Thermometers are necessarily placed in the open air, and at a suitable distance from any wall or other radiating surface, the tubes are of sufficient length to admit of their being brought inside the building, in due proximity to the recording apparatus placed in a chamber from which daylight is rigidly excluded.

The essential conditions in such an apparatus are:—

1. A means of denoting the height (in relation to a fixed horizontal line) of the mercurial column in the stem of a Thermometer.
2. A time scale denoting the exact moment at which the atmosphere reached the temperature indicated by the mark.
3. As the marks are produced chemically, and not mechanically (as in the Anemograph), a *dark* room.

A description of the drawing will show how efficiently, through the ingenuity of Mr. BECKLEY, these conditions have been obtained:—

S Wet bulb Thermometer.
T Atmospheric Thermometer.
B Screw for adjusting Thermometers.
C C Paraffin lamps or gas-lights.
D D Condensers, concentrating the light on the mirrors R R.
R R Mirrors reflecting light through air-speck in Thermometers V V.
E E Slits through which light passes from mirrors R R.
F F Photographic lenses, producing image of air-speck from both Thermometers on cylinder G.
G Revolving cylinder or drum carrying photographic paper.
H Clock, turning cylinder G round once in 48 hours.
I Shutter to intercept light four minutes every two hours, leaving white time-line on developing latent image.

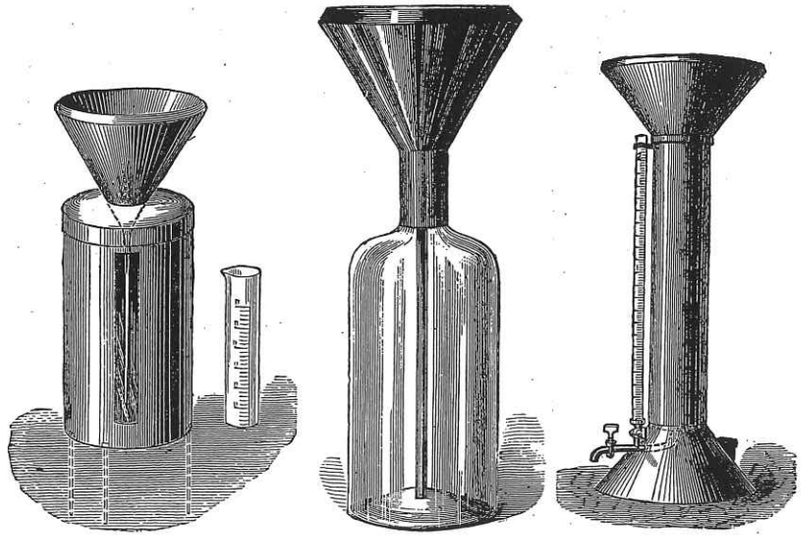
PLUVIOMETERS, or RAIN GAUGES,

Are instruments for estimating the amount of rainfall; and when the influence of rain upon the growth and quality of crops, and upon the sanitary condition of large cities is considered, it seems hardly possible to over estimate the commercial and social importance of accurate statistics on this interesting branch of weather observation.

The most important point in connection with the use of the Rain Gauge is its position and height from the ground, and this will become at once apparent when it is remembered that a fall of rain measuring 1·10 inches in depth by the Rain Gauge is nearly equivalent to 40 hogsheads per acre. Accordingly, 10 inches is the height at which meteorologists have agreed the edge of the Rain Gauge should be placed from the ground. The spot chosen should be perfectly level, and at least as far distant from any building or tree as the building or tree is high. It is also important that the Rain Gauge should be well supported, in order to avoid its being blown over by the wind; and should frost follow a fall of rain, the instrument should be conveyed to a warm room to thaw before measuring the collected contents. The graduated glass furnished with each instrument should stand quite level when measuring the rain, and the reading taken midway between the two apparent surfaces of the water.

LUKE HOWARD, in his "Climate of London," says: "It must be a subject of great satisfaction and confidence to the husbandman to know, at the beginning of a summer, by the certain evidence of meteorological results on record, that the season, in the ordinary course of things, may be expected to be a dry and warm one, or to find, in a certain period of it, that the average quantity of rain to be expected for the month has fallen. On the other hand, when there is reason, from the same source of information, to expect much rain, the man who has courage to begin his operations under an unfavourable sky, but with good ground to conclude, from the state of his instruments and his collateral knowledge, that a fair interval is approaching, may often be profiting by his observations, while his cautious neighbour, who waited for the weather to settle, may find that he has let the opportunity go by. This superiority, however, is attainable by a very moderate share of application to the subject, and by the keeping of a plain diary of the barometer and rain gauge, with the hygrometer and vane, under his daily notice."

	£	s.	d.
501. **Howard's Pedestal Rain Guage** (Fig. 177), 12 in. diameter, with glass tube graduated to inches, 10ths and 100ths of an inch, showing by direct observation the amount of rainfall, without using a graduated measure. It is furnished with a tap for emptying the Gauge. In copper	3	5	0
502. Ditto in japanned metal	2	2	0
503. **Howard's Pedestal Rain Guage**, similar to the preceding, but with boxwood scale attached to a metal float, showing amount of rainfall by direct observation. In copper	2	18	0
504. Ditto in japanned metal	2	0	0
505. **Fitzroy's Rain Gauge** with frame complete, graduated dipping tube and steadying rods or supports. In stout copper	3	3	0
506. **Livingstone's Pocket Rain Gauge**, for Tourists and Travellers, with 3-in. receiving surface and corresponding graduated glass in morocco case. In copper	0	15	6



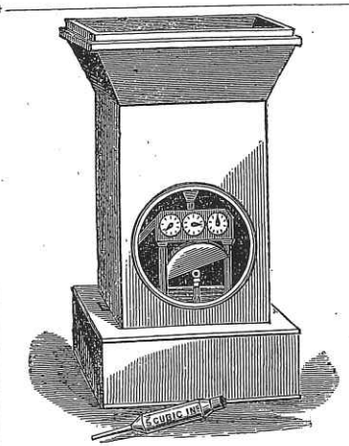
175. SYMON'S. SCALE ABOUT 1-7TH.

176. HOWARD'S. SCALE ABOUT 1-5TH.

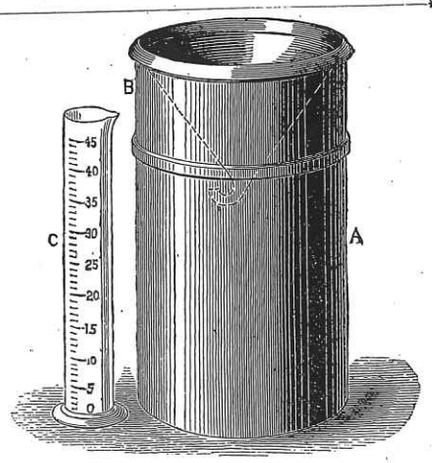
177. HOWARD'S PEDESTAL. SCALE ABOUT 1-12TH.

RAIN GAUGES.

	£	s.	d.
507. **Howard's Rain Gauge** consists of a vertical glass receiver, or bottle, through the neck of which the long terminal tube of a circular funnel, five inches in diameter, is inserted. A metal collar or tube fits over the outside of the neck of the receiver, and aids in keeping the funnel level, while the tube extends to within half an inch of the bottom, thus ensuring the retention of every drop of rain which falls within the area of the funnel. The glass vessel furnished with the instrument is graduated to 100ths of an inch. In copper	0	14	6
508. Ditto in japanned tin	0	8	6
509. Ditto ditto with best flint glass receiver (Fig. 176)	0	16	6
510. **Symons' Rain Gauge** resembles HOWARD'S, but has the advantage of having the glass receiver enclosed in a black or white japanned metal or copper jacket with openings permitting an approximate observation of the collected rain. The metal jacket is also furnished with strong iron spikes, which are firmly pressed into the soil, as shown at Fig. 175, thus ensuring perfect steadiness by its power to resist the wind. The graduated measure contains half an inch of rain (for a 5-inch area) divided into 100ths. In copper	0	18	6
511. Ditto black japan, 15/6; ditto white japan	0	16	6
512. **Symons' Rain Gauge**, with metal receiver and graduated measure, similar in construction to GLAISHER'S. In copper	0	18	6
513. Ditto in black japan, 15/6; white japan	0	16	6



178.
CROSSLEY'S
SCALE ABOUT 1-10TH.

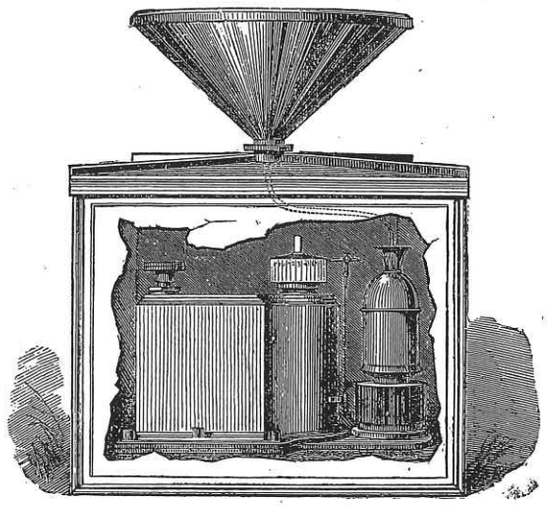


179.
GLAISHER'S
SCALE ABOUT 1-7TH.

RAIN GAUGES.

	£	s.	d.
514. **Glaisher's Rain Gauge.***—In this Gauge special provision is made, in two ways, to prevent possible loss by evaporation, even in the warmest months of the year. 1. The receiving vessel is partly sunk beneath the soil, thus keeping the contents cool. 2. The receiving surface of the funnel, accurately turned to a diameter of eight inches, terminates at its lower extremity in a curved tube, which, by always retaining the last few drops of rain, prevents evaporation. The graduated vessel, in this instance also, is divided to 100ths of an inch, having due regard to the larger area, 8-in. of the funnel (Fig. 179). In copper .	1	10	0
515. Ditto, japanned tin	1	0	0
516. **Glaisher's Rain Gauge for the Tropics.**—This instrument has an extra large receiver and tap for drawing off the rain collected, and is specially adapted for the excessive rainfall of tropical climates. In copper . .	3	0	0
517. **Crossley's Registering Rain Gauge** has a receiving surface of 100 square inches. The rain falling within this area passes through a tube to a vibrating bucket, which sets in motion a train of wheels, and these move the indices on three dials, recording the amount of rain in inches, 10ths, and 100ths. Printed directions are furnished with each instrument, and the simplicity of the mechanism ensures due accuracy. A test measure holding exactly five cubic inches of water, sent with each Gauge, affords the means of checking its readings from time to time. In japanned metal	4	10	0
518. **Square Rain Gauge,** 10-in. by 10-in., including 100 square inches of surface. Described by Col. Sir HENRY JAMES, used by the Corps of Royal Engineers. 12 inches in height, with graduated glass measure divided to 100ths of an inch. In copper	2	10	0
519. Ditto, japanned zinc	1	18	6

* If straight tubes be preferred, they are supplied without extra charge.



180.
SCALE ABOUT 1-7TH.

BECKLEY'S PLUVIOGRAPH,
OR,
SELF-RECORDING RAIN GAUGE, £36.

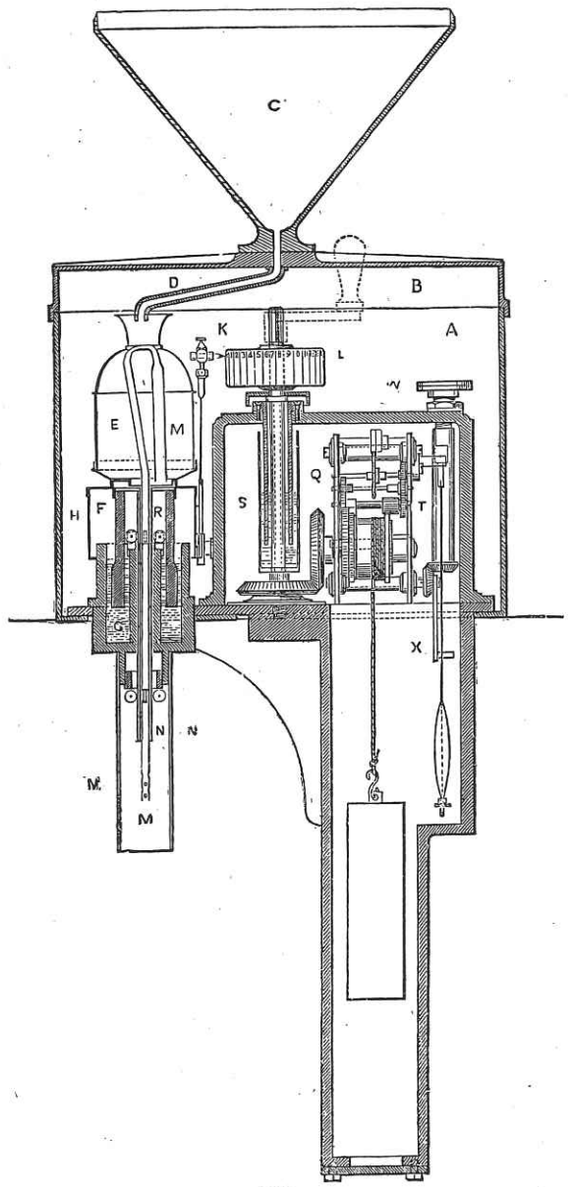
HICKS' Patent, as used at the Meteorological Stations.

520. This instrument possesses the exceptional merit of recording, with equal precision, all rain-falls, from a slight summer shower to a heavy storm of rain. It requires no special erection, and may be placed in a hole in the ground, with the receiving surface raised only a few inches above its level.

The perspective view above and the sectional engraving, on page 104, illustrate the construction of the instrument; a detailed description of which, with instructions for use, is furnished to each purchaser.

The funnel (C) has a receiving surface of 100 square inches, protected by a lip 1¼ inches deep, to retain the splashes. The rain flows into the copper receiving vessel (E), which, floating in a cistern of mercury (G), sinks and draws down with it the pencil (K), which records the event on a cylinder (L), covered with waterproof paper and moved by the clock (Q). When the receiving vessel is full the syphon (M) comes into action, rapidly drawing off *the whole* of the water, the vessel rising almost at a bound; the action being recorded by a vertical line on the cylinder. The prepared paper, bearing the time scale, should be renewed once in every 24 hours, which may be readily done by raising the hinged lid of the cast iron box (A).

Precautions are adopted to prevent injury to the clock and delicate portions of the instrument, from moisture, by adopting mercurial socket joints, which allow freedom of motion while they exclude the air. The whole outer casing and turned and enamelled funnel are of cast iron.



181.

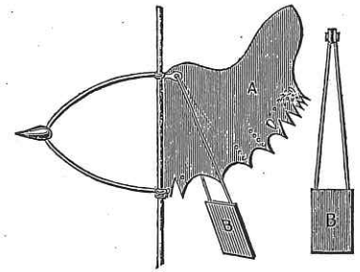
SCALE ABOUT 1-6TH.

BECKLEY'S PLUVIOGRAPH,

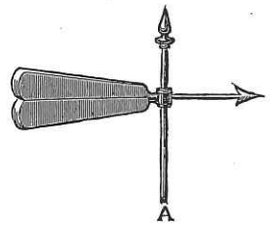
OR,

SELF-RECORDING RAIN GAUGE, £36.

HICKS' Patent, as used at the Meteorological Stations.
Self-Recording Rain Gauge by the Rev. E. STUTTER (*see Appendix*).



182.
PRESTEL'S



183.



184.

SCALE ABOUT 1-12TH.

ANEMOMETERS, or WIND GAUGES.

The scientific research and mechanical ingenuity directed of late years to producing trustworthy estimates of the direction, pressure and velocity of the wind, have resulted in a series of instruments which, for precision and accuracy, leave nothing to be desired.

Millwrights and Engineers, Meteorologists and Mariners, are equally interested in the perfection of these instruments, and the following list will be found to contain such as will meet every requirement.

The *direction* of the wind is indicated by vanes, the *velocity* by revolving cups, and the *pressure* by the pressure-plate, and by calculation from the known velocity.

521. **Prestel's Pendulum Anemometer,** for showing in a simple manner the direction and pressure of the wind. The peculiarly shaped vane ensures the surface of the swinging pressure-plate (B) being always kept towards the wind. The pendulum plate hangs, during a calm, quite vertically, indicating zero, and according as the pressure increases it will be raised through all degrees of elevation, from 1 to 10 (Fig. 182).

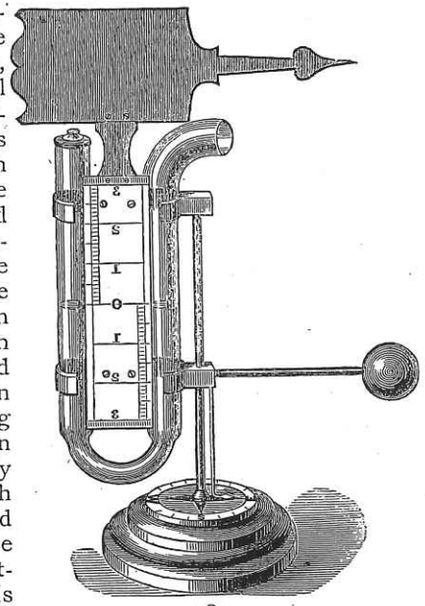
The vane is perforated with holes large enough to be visible at some distance from the ground, the 5 and 10 being specially larger, so that the angle to which the pressure-plate is raised can be quickly noted. £6 6

Table of value of indications in English and French measures :—

Scale of Pend. Anemo.	Pressure in Kilogrs. on Sq. Metre.	Mountain Scale.	Elevation of Pendulum	Description of Wind.	Pressure in lbs. on Square Foot.
0	0	0	0	Calm	0
1	1	0·5	5°	Gentle motion of air . .	0·2044
2	4	1·0	20°	Light breeze	0·8176
3	9	1·5	35°	Fresh (top-gallant W.) .	1·8396
4	15	2·0	45°	Stiff strong (top-galt. W.)	3·0650
5	25	2·5	54°	Very stiff (topsail W.) .	5·1110
6	36·8	3·0	60°	Strong rushing wind (to house top-gallant) . .	7·5119
7	49	3·5	64°	Stormy W. (to house topsails)	10·0156
8	64	4·0	67°	Gale of wind	13·0816
9	81·6	4·5	69½°	Strong gale	16·6790
10	100	5·0	70°	Hurricane	20·4408
	143·6	—	74°		29·3518

FRENCH MEASURES. — ENGLISH MEASURES.

522. **Lind's Anemometer, or Wind Gauge,** ranks among the earliest forms of instruments designed to estimate the force of the wind. It consists of a glass syphon, the limbs of which are parallel to each other, mounted on a vertical rod, on which it freely oscillates by the action of the vane which surmounts it. The upper end of one limb of the syphon is bent outward at right angles to the main direction, and the action of the vane keeps this open end of the tube always towards the quarter from whence the wind blows. Between the limbs of the syphon is placed a scale graduated from 0 to 3 in inches and 10ths, the zero being in the centre of the scale. When the instrument is used, it is only necessary to fill the tube with water to the zero of the scale and then expose it to the wind. The natural consequence of wind acting on the surface of the water is to depress it in one limb and raise it in the other, and the sum of the depression and elevation is the height of a column of water which the wind is capable of sustaining at the time of observation. Sudden gusts of wind are apt to produce a jumping effect on the water in the tube, and to diminish this, the bend of the syphon is contracted. A brass compass dial at the foot shows the direction of the wind (Fig. 185). £2 0 0



185.
SCALE ABOUT 1-5TH.

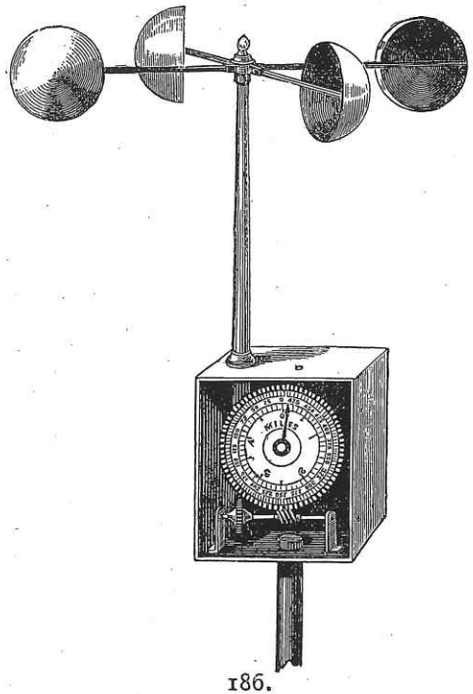
522a. **Sir W. Snow Harris's Wind Gauge** £2 10 0

The following Table shows the force of wind on a square foot, for different heights of the column of water in LIND's Wind Gauge:—

Inches.	Force in lbs. per Square Foot.	Common designation of such Wind.
6	31·75	A Hurricane.
5	26·04	A Violent Storm.
4	20·83	A Great Storm.
3	15·62	A Storm.
2	10·42	A Strong Wind.
1	5·21	A High Wind.
·5	2·60	A Brisk Wind.
·1	·52	A Fresh Breeze.
·05	·26	A Gentle Breeze.
0·	0·	A Calm.

523. **Beckley's Improved Anemometer.**—It will be seen by the illustration that this is a simplification of ROBINSON's. The hemispherical cups are retained, but the index portion of the instrument consists of two graduated concentric circles, the inner one representing five miles divided into 10ths, and the outer one bearing 100 divisions, each of which is equivalent to five miles. At the top of the dial is a fixed index, which, as the toothed wheel revolves, marks on the inner circle the miles (up to five) and 10ths of miles the wind has travelled, while a moveable index, which revolves with the wheel, indicates on the outer circle the passage of every five miles.

This instrument can be made very portable by removing the arms bearing the cups, when the whole may be packed with iron shaft in a case 15 × 13 × 4 inches. It may be placed in any desired position by screwing the iron shaft supplied with it into the hole provided for the purpose, and fixing the apparatus on a pole or other elevated stand, if possible, in an open space exposed to the *direct* action of the wind.



186.
SCALE ABOUT 1-5TH.

If, when placing the instrument, the hands stand at 0, the next reading will, of course, show the number of miles the wind has traversed; but, should they stand otherwise, the reading may be noted and deducted from the second reading, thus: Suppose the fixed index points to 2·5 and the moveable index to 125, the reading, after 12 hours may be 200 on the outer circle and 3·0 on the inner circle; these added together yield 203. By deducting the previous reading, 127·5, we have the true reading—viz., 75·5 miles as the distance travelled by the wind (Fig. 186). £4 4 0

523A. In case, complete £4 10 0

Having obtained the velocity of the wind in this manner in miles per hour, the valuable Table (page 108) from Col. Sir HENRY JAMES' "Instructions for Taking Meteorological Observations" will enable the observer to calculate the pressure in pounds per square foot.

524. **Beckley's Anemometer** with enamel dial, on 3-ft. octagonal pedestal of cast iron, highly finished (like Fig. 186) . £7 10 0

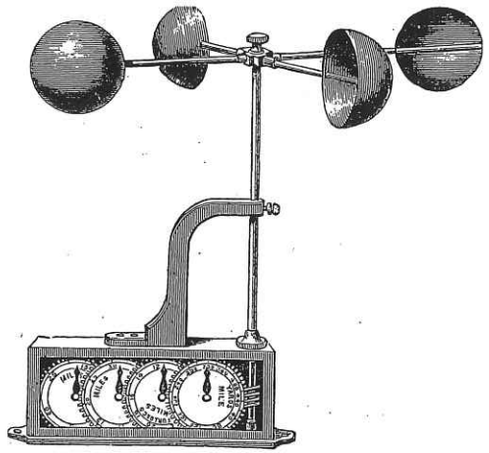
525. **Osler's Registering Anemometer and Rain Gauge** shows the direction, pressure and velocity of the wind, also the rainfall, by suitable recording apparatus, on one sheet of paper. From £70 to £100.

Velocity and Pressure of the Wind.

The Pressure varies as the Square of the Velocity, or $P \propto V^2$. The Square of the Velocity in Miles per Hour multipled by ·500 gives the Pressure in lbs. per square Foot, or $V^2 \times \cdot 005 = P$. The Square Root of 200 Times the Pressure equals the Velocity or $\sqrt{200 \times P} = V$.

The subjoined Table is calculated from this data, by Col. Sir Henry James, of the Ordnance Survey Office.

Pressure in lbs. per Square Foot.	Velocity in Miles per Hour.	Pressure in lbs. per Square Foot.	Velocity in Miles per Hour.	Pressure in lbs. per Square Foot.	Velocity in Miles per Hour.	Pressure in lbs. per Square Foot.	Velocity in Miles per Hour.	Pressure in lbs. per Square Foot.	Velocity in Miles per Hour.
oz.		lbs.		lbs.		lbs.		lbs.	
0·08	1·000	6·75	36·742	17·75	59·581	28·75	75·828	39·75	89·162
0·25	1·767	7·00	37·416	18·00	60·000	29·00	76·157	40·00	89·442
0·50	2·500	7·25	38·078	18·25	60·415	29·25	76·485	40·25	89·721
0·75	3·061	7·50	38·729	18·50	60·827	29·50	76·811	40·50	90·000
1·00	3·535	7·75	39·370	18·75	61·237	29·75	77·136	40·75	90·277
2·00	5·000	8·00	40·000	19·00	61·644	30·00	77·459	41·00	90·553
3·00	6·123	8·25	40·620	19·25	62·048	30·25	77·781	41·25	90·829
4·00	7·071	8·50	41·231	19·50	62·449	30·50	78·102	41·50	91·104
5·00	7·905	8·75	41·833	19·75	62·849	30·75	78·421	41·75	91·378
6·00	8·660	9·00	42·426	20·00	63·245	31·00	78·740	42·00	91·651
7·00	9·354	9·25	43·011	20·25	63·639	31·25	79·056	42·25	91·923
8·00	10·000	9·50	43·588	20·50	64·031	31·50	79·372	42·50	92·195
9·00	10·606	9·75	44·158	20·75	64·420	31·75	79·686	42·75	92·466
10·00	11·180	10·00	44·721	21·00	64·807	32·00	80·000	43·00	92·736
11·00	11·726	10·25	45·276	21·25	65·192	32·25	80·311	43·25	93·005
12·00	12·247	10·50	45·825	21·50	65·574	32·50	80·622	43·50	93·273
13·00	12·747	10·75	46·368	21·75	65·954	32·75	80·932	43·75	93·541
14·00	13·228	11·00	46·904	22·00	66·332	33·00	81·240	44·00	93·808
15·00	13·693	11·25	47·434	22·25	66·708	33·25	81·547	44·25	94·074
		11·50	47·958	22·50	67·082	33·50	81·853	44·50	94·339
lbs.		11·75	48·476	22·75	67·453	33·75	82·158	44·75	94·604
1·00	14·142	12·00	48·989	23·00	67·823	34·00	82·462	45·00	94·868
1·25	15·811	12·25	49·497	23·25	68·190	34·25	82·764	45·25	95·131
1·50	17·320	12·50	50·000	33·50	68·556	34·50	83·066	45·50	95·393
1·75	18·708	12·75	50·497	23·75	68·920	34·75	83·366	45·75	95·655
2·00	20·000	13·00	50·990	24·00	69·282	35·00	83·666	46·00	95·916
2·25	21·213	13·25	51·478	24·25	69·641	35·25	83·964	46·25	96·176
2·50	22·360	13·50	51·961	24·50	70·000	35·50	84·261	46·50	96·436
2·75	23·452	13·75	52·440	24·75	70·356	35·75	84·567	46·75	96·695
3·00	24·494	14·00	52·915	25·00	70·710	36·00	84·852	47·00	96·953
3·25	25·495	14·25	53·385	25·25	71·063	36·25	85·146	47·25	97·211
3·50	26·457	14·50	53·851	25·50	71·414	36·50	85·440	47·50	97·467
3·75	27·386	14·75	54·313	25·75	71·763	36·75	85·732	47·75	97·724
4·00	28·284	15·00	54·772	26·00	72·111	37·00	86·023	48·00	97·979
4·25	29·154	15·25	55·226	26·25	72·456	37·25	86·313	48·25	98·234
4·50	30·000	15·50	55·677	26·50	72·801	37·50	86·602	48·50	98·488
4·75	30·822	15·75	56·124	26·75	73·143	37·75	86·890	48·75	98·742
5·00	31·622	16·00	56·568	27·00	73·484	38·00	87·177	49·00	98·994
5·25	32·403	16·25	57·008	27·25	73·824	38·25	87·464	49·25	99·247
5·50	33·166	16·50	57·445	27·50	74·161	38·50	87·749	49·50	99·498
5·75	33·911	16·75	57·879	27·75	74·498	38·75	88·034	49·75	99·749
6·00	34·641	17·00	58·309	28·00	74·833	39·00	88·317	50·00	100·000
6·25	35·355	17·25	58·736	28·25	75·166	39·25	88·600		
6·50	36·055	17·50	59·160	28·50	75·498	39·50	88·881		



187.

Scale about 1-6th.

ANEMOMETERS.

526. **Robinson's Anemometer.**—This instrument, the invention of Dr. Robinson, of Armagh, was first used in 1850. It consists of four hemispherical cups (which are of copper) attached to two horizontal metal arms in such a manner that their concave surfaces all face one way. The vertical axis upon which these are secured has, at its lower extremity, an endless screw placed in gear with a train of wheels and pinions. Each wheel is graduated respectively to 1-10th, 1 mile, 10 miles, 100 miles, 1000 miles, and these revolve behind a fixed index, the readings of which are necessarily taken backwards, according to the indications on the dials (Fig. 187).

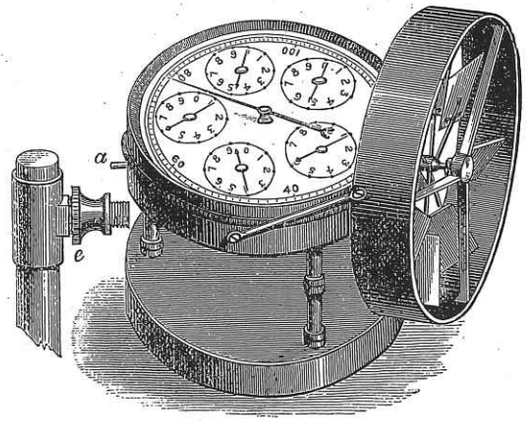
Dr. Robinson entertained the theory that the cups (measuring from their centres) revolved with one-third of the wind's velocity; and this theory having been fully supported by experiment, due allowance has been made in graduating the wheels so that the true velocity is obtained by direct observation. £3 3 0

Directions for using Robinson's Anemometer.—

The first dial indicates so many hundreds of thousands of revolutions, or miles, according to mode of division; the second, tens of thousands; the third, thousands; the fourth, hundreds; and the fifth, tens. Readings should be taken every morning. Should the index point *between* two figures, the lesser of the two is to be taken. Whenever the index of the first dial is found to have passed zero (O), a cross or star is to be prefixed to the next (a lower) reading.

The number of *thousands* of revolutions made during a month is ascertained by subtracting the first reading from the last, and prefixing to the figures thus obtained a figure corresponding to the number of stars in the column. Every thousand revolutions represents two miles of wind, and the number of miles which have passed in a month is ascertained, therefore, by multiplying by two.

To ascertain the velocity of the wind during a *short* period:—Take two readings of all the dials with an interval of twelve minutes. The difference of these readings, divided by ten, is the velocity of the wind in miles per hour.



188.
SCALE ABOUT ½.

AIR-METERS, WIND VANES, &c.

527. **Air Meter,*** for Measuring the Velocity of Air Currents in Sewers, Mines, Hospitals, &c. The illustration shows that the indications are obtained by the revolution of a series of fans (similar to those in BIRAM'S Anemometer) acting first on a long hand capable of recording the low velocity of fifty feet per minute on the large dial divided to 100 feet, and then successively by a train of wheels on the indices of five smaller dials, each divided into ten parts, and recording respectively 1000, 10,000, 100,000 and 10,000,000 feet, or 1893 miles, an amount found to be more than adequate to the most protracted observations. This Portable Air Meter forms an admirable Pocket Anemometer for tourists (Fig. 188). £4 0 0

528. **Air Meter,** similar to the preceding, the larger dial recording 100 feet and one smaller dial 1000 feet. £3 10 0

529. **Wind Vanes.**—The variety of patterns and sizes of these useful adjuncts to a Meteorological Station is so great as to preclude the possibility of quoting prices. Two illustrations are given (Figs. 183 and 184) to indicate useful forms, and estimates will be sent on learning the size required and the position the Vane is to occupy.

It may be here mentioned, for the guidance of customers at a distance, that it is sometimes deemed desirable to associate a lightning conductor† with a Wind Vane. Furthermore, it is of the highest importance, in adjusting the points of the Vane, to see that the north point coincides completely with the true Geographical North, and not with the Magnetic North.

530. **Portable Wind Vane, or Anemoscope.**—This is a simple contrivance arranged by Dr. HALLEUR for the convenience of travellers. It is furnished with a compass and bar needle, &c., and will tell the true direction of the wind to within a half point. £2 0 0

* This instrument is employed for testing the ventilation in our Coal Mines, Houses of Parliament, and in the Senate Houses of the United States.

† For prices of Lightning Conductors see Appendix.

Biram's Anemometer.—This is an ingenious and trustworthy "tell-tale" instrument for registering currents of air in mines, &c., and thus showing whether the furnace man, who is responsible for due ventilation, is mindful of his duty.

It consists of a series of light vanes arranged at an angle for catching the wind, on an axis, the revolutions of which are recorded on a series of dials marked respectively "X.C.M.," "X.M.," "C.M." and "M.," the divisions on which denote units of the denominations of the respective circles.

In using it, a note is made of the position of the several indices, and deducting their amount from their position at the second observation according to directions, furnished with each instrument.

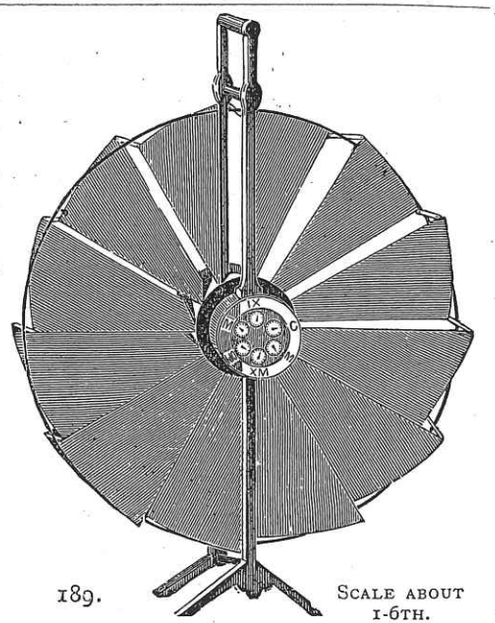
A portable pocket series is made, of 6-in., 4-in., and 2¼-in. diameter, applicable in any part of a mine.

In large gun or rifle practice the pocket size of this instrument yields trustworthy results.

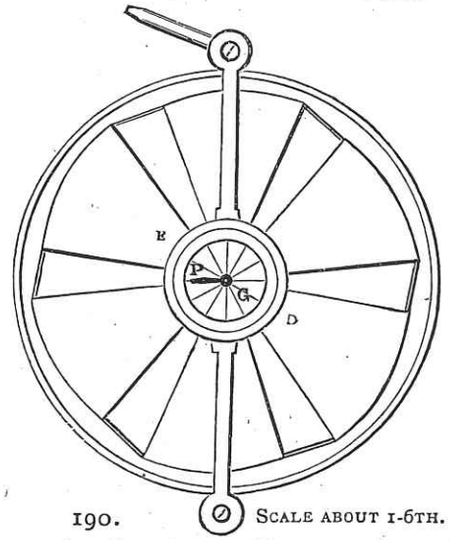
To ascertain the rate at which the air is moving, proceed thus: Suppose 100 revolutions = 200 feet per minute—

$$200 \div 88 = 2{\cdot}27$$

say 2¼ miles per hour, 88 being 1-60th of a mile.

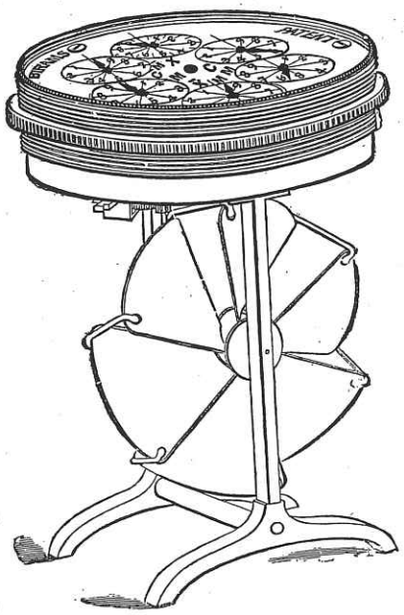


189. SCALE ABOUT 1-6TH.



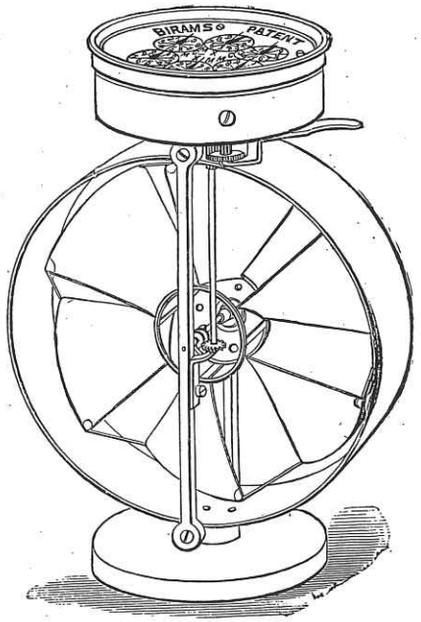
190. SCALE ABOUT 1-6TH.

	£	s.	d.
531. **Biram's Anemometer,** 12-in. diameter, reading to 10,000,000 feet (Fig. 189)	4	4	0
532. **Biram's Anemometer,** 6-in. do., reading to 1000 ft.	3	3	0
533. **Biram's Anemometer,** 4-in. do., reading to 100 ft. (Fig. 190)	2	10	0
534. **Biram's Anemometer,** 2-in. do., new, reading to 10,000,000 ft. (Fig. 191)	3	15	0
535. **Biram's Anemometer,** 6-in. do., with disconnector, reading to 1000 feet	3	13	6
536. **Biram's Anemometer,** 4-in. do., with disconnector, reading to 10,000,000 ft. (Fig. 192)	4	4	0



SCALE ABOUT ½

191.



SCALE ABOUT ½

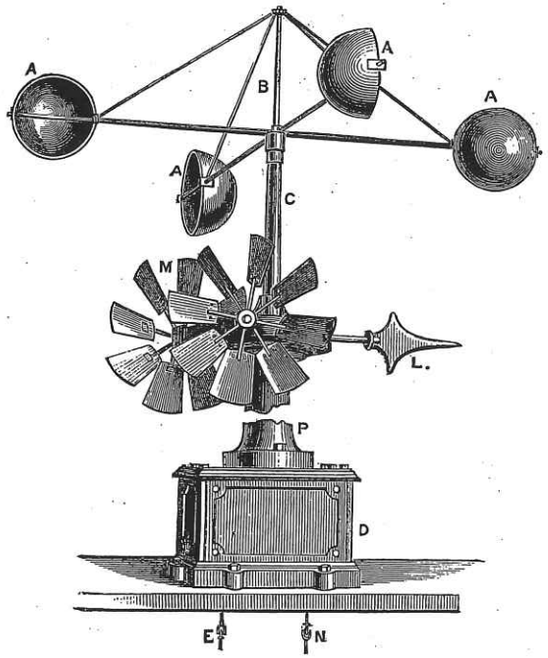
192.

Table for finding the Force of Air Currents by BIRAM's Anemometer.

Feet per Minute.	Feet per Second.	Miles per Hour.	Force in lbs. per Sq. Foot.	Description.
50	·83	·568	·0016	Hardly perceptible.
100	1·66	1·136	·0061	Just perceptible.
200	3·33	2·272	·0255	
300	4·99	3·408	·0574	Gentle Breeze.
400	6·66	4·544	·1021	
500	8·33	5·680	·1595	
750	12·50	8·522	·3593	Pleasant Breeze.
1000	16·66	11·363	·6388	
2000	33·33	22·726	2·5553	Brisk Gale.
3000	49·99	34·089	5·6982	High Wind.
4000	66·66	45·452	10·2214	Very High Wind.
5000	83·33	56·815	16·4429	Storm.
6000	99·99	68·178	22·9954	Great Storm.
7000	116·66	79·541	31·3019	Hurricane.
8000	133·32	90·904	40·8807	
9000	149·99	102·267	51·6920	
10000	166·66	113·630	60·8837	

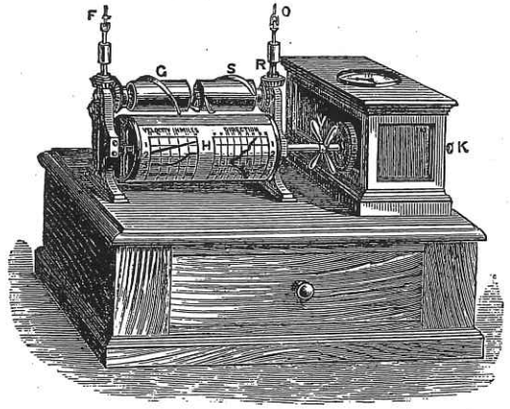
To find the force of wind, multiply the square of the velocity of the wind in feet per second by ·0023.

NOTE.—The velocity of the wind in feet per minute, divided by 88, will give the velocity in miles per hour. *(See example, page 111.)*



193.

Portion for Exterior of Observatory.



194.

Portion for Interior of Observatory.

SCALE ABOUT 1-20TH.

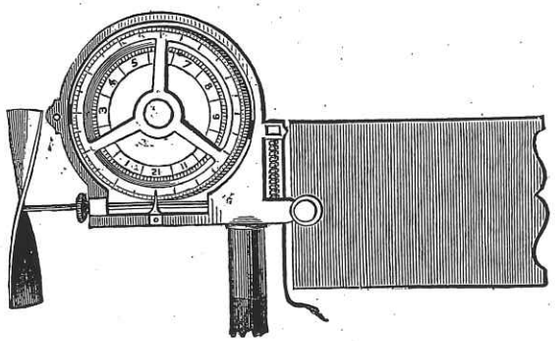
537. *ANEMOGRAPH,

OR

SELF-RECORDING WIND GAUGE, £70.

Registering inside the dome, or roof. If Recording apparatus be placed on any floor below this, a proportionate increase of price will be charged.

*For description see page 14.



195.

SCALE ABOUT 1-4TH.

TIDE GAUGE, &c.

538. **Self-Recording Tide Gauge.**—An apparatus for recording, by a pencil line on a paper-covered cylinder driven by pendulum clock-work, the amount of, and the rate at which the tide rises and falls, and constructed for the most part of brass and iron, with copper chain and float. The float being the source of the indications, the machinery is so placed that it may come directly over a pipe or well 20 inches in diameter, either in the sea or communicating with it.

It is essential that this pipe be of such a length that its lowest portion, covered with a grating to prevent the surging of the waves and exclude sea-weed, should be under the level of the lowest neap tides.

The rising and falling of the float within this pipe communicates by a copper-chain, motion to a train of wheels actuating the recording pencil, while the clock revolves the cylinder bearing the prepared divided paper. The scale may be divided to suit the exigencies of a particular locality; that used by the Admiralty gives half an inch to the hour, and four-tenths of an inch to the foot. £50 to £80

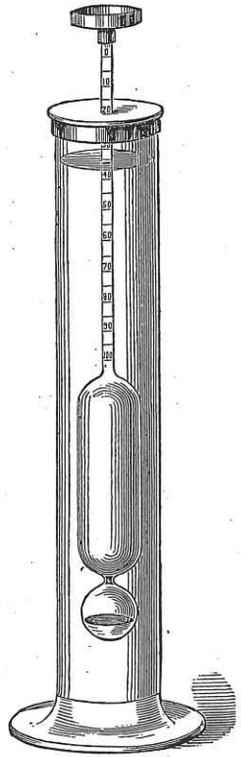
539. **Current Meter,** for use in small rivers and streams, to show rate of flow of tide or number of gallons flowing from any reservoir or vessel (Fig. 195) £6 6 0

540. **Cloud Reflector.**—A horizontal mirror, having the cardinal points marked on its margin, so placed that the part marked "north" may coincide with the southern point of the horizon, thus reversing all the several points of the compass. To ascertain the true point of the compass *from which* clouds are coming, the observer, keeping perfectly still, so places the mirror as to bring the well-defined edge of a conspicuous cloud to coincide with the centre, and notes on the margin, the point at which it passes away. This cloud mirror was exhibited by Mr. GODDARD, at the International Exhibition, 1862. (To order.)

541. **Goddard's Sunshine Recorder.**—A revolving drum, or cylinder, is covered with sensitized photographic paper and connected with clockwork, which turns the cylinder once round in 24 hours; the sun's rays being allowed to fall on the paper through a very narrow opening, and the paper, removed from the drum, developed and fixed in the usual manner, yields a photographic record of the sunshine of each day. (To order)

542. **Babington's Atmidometer,** for measuring the rate of evaporation from water, ice, or snow, in form resembles a Hydrometer, with the difference that the stem contains a scale graduated to grains and half grains, and is surmounted by a light, shallow copper pan. When in use, the Hydrometer-like instrument is immersed in a glass vessel having a hole in the cover, through which the stem protrudes. The copper pan is then placed on the top, and sufficient water, ice, or snow, placed therein to sink the stem to the zero of the scale. As the evaporation proceeds, the stem rises; and, if *time* of commencing the experiment is noted, the rate as well as the amount of evaporation, is indicated in grains. Small size (Fig. 196) . £2 5 0

543. **Babington's Atmidometer,** large size, with copper tank, for Observatories £3 10 0



196.

SCALE ABOUT 1-5TH.

OZONOMETERS.

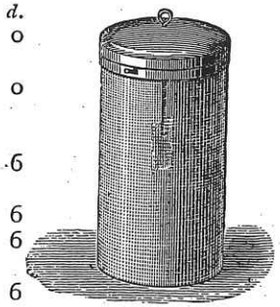
SCHONBEIN, the discovererof Ozone, found that when strips of paper previously saturated with starch and iodide of potassium and dried, were exposed freely to the air but protected from rain and the direct action of the sun, they underwent a peculiar discolouration when immersed in water after an exposure of 24 hours. A scale of tints numbered from one to ten afforded the means of comparative observation, and thus the Ozonometer was constructed.

544. **Schonbein's Ozonometer.**—A series of test-papers enclosed in case, sufficient for 12 months, with set of 12 comparative tints £0 6 6

545. **Moffat's Ozonometer.** Test Papers prepared by Dr. Moffat's formula, with set of 10 comparative tints . 0 8 6

For the proper exposure of the chemically prepared papers an Ozone Cage is necessary.

	£	s.	d.
546. **Sir James Clarke's Ozone Cage,** in copper (Fig. 197) . .	1	5	0
547. **Sir James Clarke's Ozone Cage,** japanned	0	18	0
548. **Sir James Clarke's Ozone Cage,** small size, for Travellers, japanned	0	10	6
549. **Sir James Clarke's Ozone Cage,** in copper	0	12	6
550. **Sedan's Ozonometer** . .	0	8	6
551. **Lowe's Spiral Ozone Case,** japanned zinc	0	18	6
552. **Moffat's Ozone Box,** painted deal	1	1	0



197.

SCALE ABOUT 1-6TH.

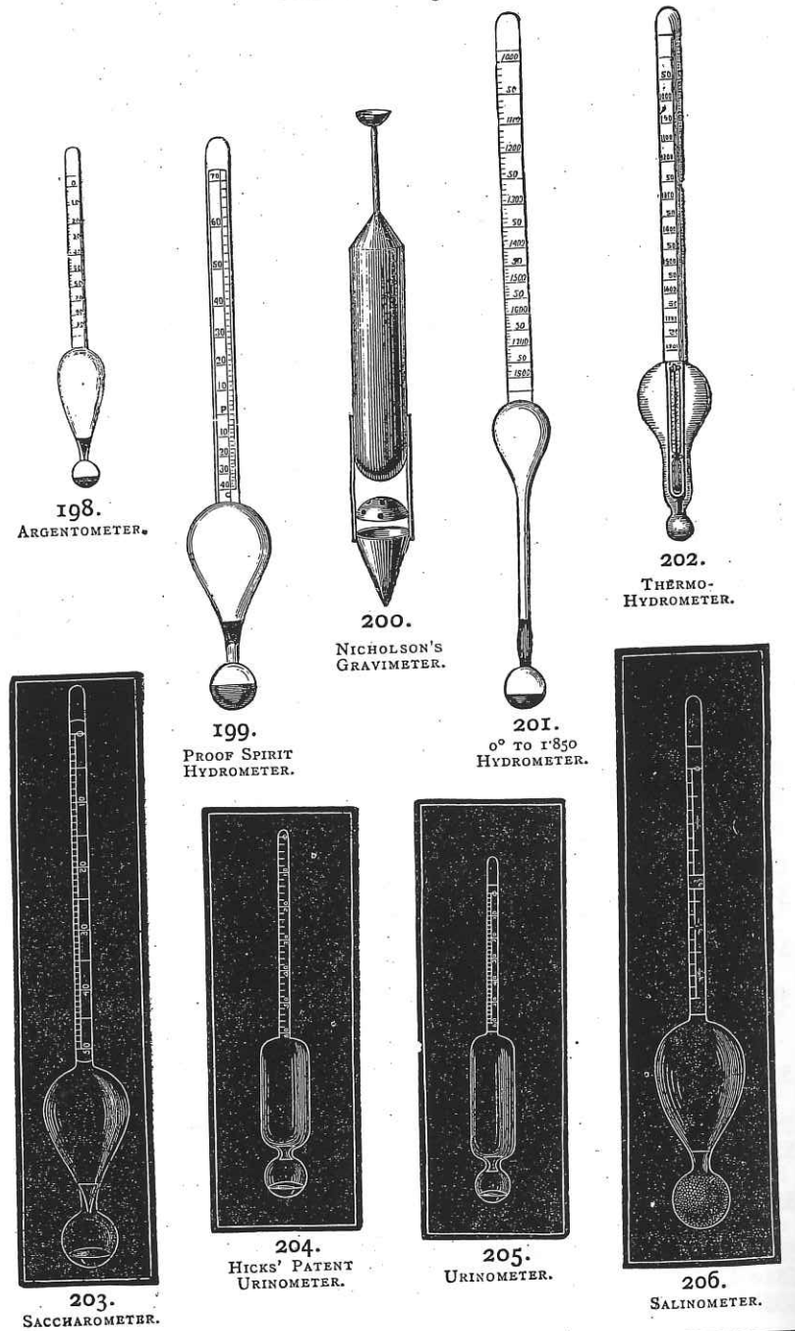
553. **Siemen's Ozone Tube** £1 7 6

554. **Tisley's Ozone Tube,** small 21/0; large . . 3 3 0

555. **Lankester's Registering Ozonometer** . . 10 10 0

HYDROMETERS, SACCHAROMETERS, &c.

SCALE ABOUT 1-3RD.



198. ARGENTOMETER.

199. PROOF SPIRIT HYDROMETER.

200. NICHOLSON'S GRAVIMETER.

201. 0° TO 1·850 HYDROMETER.

202. THERMO-HYDROMETER.

203. SACCHAROMETER.

204. HICKS' PATENT URINOMETER.

205. URINOMETER.

206. SALINOMETER.

HYDROMETERS.

These instruments are representative of a class (*e.g.*, Salinometers, Urinometers, &c.) made for readily ascertaining the specific gravity of fluids, on the long-established principle that "a body immersed in any liquid receives a pressure from below, upwards, equal to the weight of the volume of liquid displaced by such body."

They give the specific gravities of liquids by observing the degree to which they sink in the fluids. There are two classes of Hydrometers, —one of constant immersion, the other of variable immersion.

The instruments of constant immersion necessitate the employment of weights, with tables and directions, which accompany each instrument, and include NICHOLSON'S Gravimeter, SIKES'S Hydrometer, BATES'S Patent Saccharometer, and the Brewers' Metal Saccharometer.

The instruments of variable immersion include all Hydrometers which show direct specific gravity, *e.g.*, Proof Hydrometers, TWADDLE'S Hydrometers, Urinometers, Lactometers, Saccharometers.

The specific weights or gravities of all liquids and solids are referred to distilled water as a common standard. For this purpose, a light glass flask is blown, of such a size as to hold exactly 1000 grains of pure distilled water, at a temperature of 60° F. It will be obvious that in such a flask, if *accurately* adjusted, a standard instrument is obtained, into which, if a light liquid, like ether, be poured, until it reaches a notch in the neck indicating the height of the 1000 grains of water, and the whole be weighed, the specific gravity (or weight, in relation to an equal bulk of water) of the ether will be obtained. In like manner, if the flask be filled to the same mark with oil of vitriol, it will be found to weigh about 1.845 grains, thus showing the specific gravity of strong sulphuric acid to be *nearly* double that of water. This mode of proceeding, however, is found to be too tedious for business purposes, and recourse is, therefore, had to the principle above stated, by constructing instruments with graduated stems, suited for liquids heavier and lighter than water, which are known as Hydrometers.

		£	s.	d.
556.	**Glass Hydrometer** for pocket, condensed scale and trial-glass, with Thermometer, in velvet-lined morocco case, hinged lid	0	12	6
557.	**Glass Hydrometer** for pocket, condensed scale and trial-glass, in double pull-off morocco case . .	0	5	0
558.	**Glass Hydrometer** for fluids heavier than water, from 1·000 to 1·850 (Fig. 201)	0	5	0
559.	**Glass Hydrometer** for liquids lighter than water, *e.g.*, proof spirit, &c., ·700 to 1·000	0	4	0
560.	***Glass Hydrometer** for proof spirit, from 40° under to 70° over proof, in metal case (Fig. 199) . . .	0	3	6

* Directions for use are furnished with each instrument, together with tables of corrections for temperature, which, however, are unnecessary, if, before testing, the spirit is adjusted by a Thermometer to 60° of temperature, when the scale of the Hydrometer gives the exact strength of the spirit.

HYDROMETERS.

	£	s.	d.
561. **Hicks' Patent Hydrometer**, for proof spirit	0	5	0
562. **Acetometer**, for testing vinegar, acetic acid	0	3	6
563. **Ammoniameter**, for testing ammoniacal liquors, liquid ammonia, &c., in metal case	0	3	6
564. **Aquarium Hydrometer**, for testing artificial sea water, 0° to 40°, in metal case	0	3	6
565. **Oleometer**, for testing the strength of oils, ivory scales in metal case	0	3	6
566. **Gay Lussac's Alcoholometer**, as used in France, ivory scale, in metal case	0	4	0
567. **Tralle's Alcoholometer**, as used in Prussia and the United States	0	4	0
568. **Barktrometer**, open graduations, ivory scale, for testing liquor of tan-pits, from 0° to 60° in grains	0	3	6
569. **Board of Trade Hydrometer**, for showing the specific gravity of sea water, 0° to 40°	0	3	6
570. **Board of Trade Hydrometer**, same scale as above, in two, Hydrometer 0° to 20° and 20° to 40°, for showing specific gravity of sea water	0	3	6
571. **Cartier's Hydrometer**, for light fluids, ivory scales, in metal case	0	3	6
572. **Schoeffer's Hydrometer**, a narrow cylinder, with solution tube, in case, ·700 to 1·000	0	4	6
573. **Schoeffer's Hydrometer**, a narrow cylinder, with solution tube, 1·000 to 1·900 specific gravity	0	4	6
574. **A Set of 3 Hydrometers**, specific gravity. No. 1, ·700 to 1·000; No. 2, 1·000 to 1·500; No. 3, 1·500 to 1·900, ivory scales, in metal cases	0	15	0
575. **A Set of 3 Hydrometers**, with paper scales	0	12	6
576. **A Set of 4 Hydrometers**, divided every two degrees, No. 1, ·700 to 1·000; No. 2, 1·000 to 1·300; No. 3, 1·300 to 1·600; No. 4, 1·600 to 1·900 specific gravity, ivory scales, in metal case	1	1	0
577. **A Set of 4 Hydrometers**, with paper scales	0	18	6
578. **Polished Mahogany Box and Trial Glass** for set of three Hydrometers	0	10	6
579. **Polished Mahogany Box, Trial Glass and Thermometer**, for set of four Hydrometers	0	15	6
580. **Sikes' Hydrometer** of Glass, with ivory scale Thermometer, slide rule, and trial jar, in polished mahogany case	1	1	0
581. **Sikes' Hydrometer** of Glass, ivory scale, trial glass, in polished mahogany box	0	10	6
582. **Sikes' Hydrometer** of Glass, ivory scale, trial glass, and Thermometer, in polished mahogany box	0	16	6
583. **Hydrometer for Spirit**, with Thermometer inside, scale 0 to ·100, with Sikes' book of tables, instructions, trial glass, slide rule, in polished mahogany box (Fig. 202)	1	5	0
584. **Hydrometer and Saccharometer** (combined) of Glass with Thermometer in mahogany box	0	18	6

HYDROMETERS.

Beaumé's Hydrometers are much used in this country, as well as in France. There are two kinds—one for liquids heavier than water, called, for distinction, "BEAUMÉ's Acidometer;" another for liquids lighter than water, and called "BEAUMÉ's Spirit Hydrometer."

	£	s.	d.
585. **Beaumé's Acidometer**	0	3	6
586. **Beaumé's Spirit Hydrometer**	0	3	6

Specific Gravities corresponding to Degrees of BEAUMÉ's Hydrometer.

Liquids Lighter than Water.		Liquids Heavier than Water.	
Degrees.	Specific Gravities.	Degrees.	Specific Gravities.
12	0·986	1	1·007
15	0·967	3	1·020
18	0·948	5	1·034
21	0·930	7	1·048
24	0·913	9	1·063
27	0·896	11	1·078
30	0·880	13	1·094
33	0·864	15	1·109
36	0·849	17	1·126
39	0·834	19	1·143
42	0·820	21	1·160
45	0·807	23	1·178
48	0·794	25	1·197
51	0·781	27	1·216
54	0·768	29	1·235
		31	1·256
		32	1·277
		35	1·299
		37	1·321
		39	1·345
		41	1·369
		43	1·395
		50	1·490
		60	1·652
		70	1·854

ARGENTOMETERS.

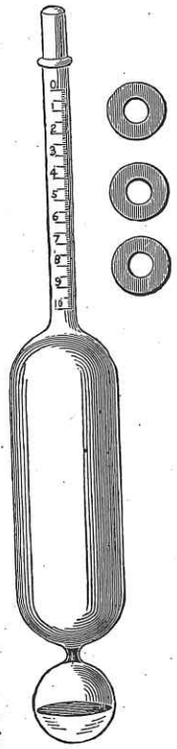
	£	s.	d.
587. **Argentometer**, or Photographic Bath Tester, 6-in., for testing strength of silver bath (Fig. 198)	0	3	6
588. **Argentometer**, or Photographic Bath Tester, with trial glass, in double pull-off paper case	0	4	6
589. **Argentometer**, for determining grains per ounce in photographic nitrate of silver bath, by test solution of chloride of sodium	0	4	0
590. **Argentometer**, same as preceding, in morocco case	0	5	0

HICKS' PATENT SALT WATER HYDROMETER.

The instruments hitherto in use for testing the specific gravity of sea water have been found not sufficiently sensitive to indicate the very slight variations which occur in different latitudes, and at different depths; the graduations on the scale being so close to each other as to render it nearly impossible to read to anything less than a grain.

This having been mentioned to me by Mr. Scott, of the Meteorological Office, induced me to construct a new instrument, of which the following is a description:—

In its leading features it resembles an ordinary Hydrometer, ranging from 0 to 10 grains on the stem, with three perforated metal discs of *exactly* equal weight, which are successively added to the top of the stem as occasion requires. When the first is applied, 0° on the scale becomes equal to 10°, the second being added makes 0° equal to 20°, and when the third is used 0° becomes 30°, and the division 10° on the stem is equal to 40°.



207.
SCALE ABOUT ½.

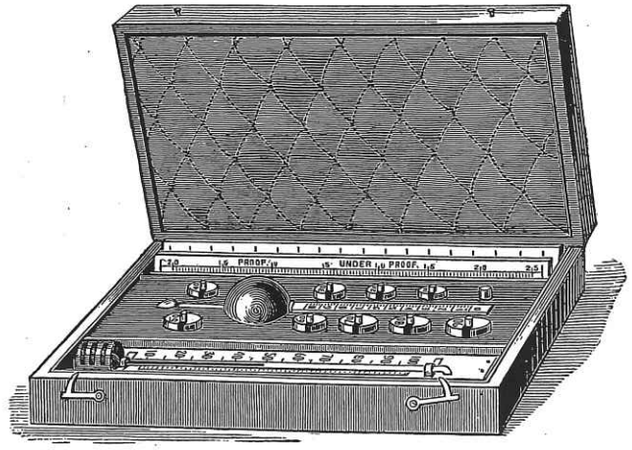
By this means one delicate Hydrometer answers the purpose of four by the re-immersion of the same stem.

Should this be found in practice to be too delicate, I make another and stronger form, with only one weight, in which the stem ranges from 0° to 20°, while the addition of the weight 0° is equal to 20, and 20 on the stem is equal to 40°.

These instruments possess the further advantage of having the divisions and figures engraved in black on a white enamelled stem, which greatly facilitates the readings. The divisions and figures are also incorrodible.

	£	s.	d.
591. **Hicks' Patent Salt Water Hydrometer,** No. 1, with three weights, in mahogany box (Fig. 207) . .	0	12	6
592. **Hicks' Patent Salt Water Hydrometer,** No. 2, with one weight, in mahogany box	0	10	6
593. **Hicks' Patent Salinometer** is manufactured entirely of glass, the usual paper scale being replaced by a scale divided and figured in black *on* white opal glass, thus avoiding errors from shifting of scale, melting of wax at high temperatures, or corrosion, as with metal (Fig. 206)	0	5	0
594. **Hicks' Patent Salinometer,** in velvet-lined mahogany case, with Thermometer	0	15	6
595. **Hicks' Patent Salinometer** with Thermometer, in mahogany case and copper pot complete . . .	2	0	0

The water of the Ocean varies in specific gravity, from 1·020 to 1·036, the ordinary density being from 1·026 to 1·028. The Mediterranean Sea has a density of 1·030, and the Carribean Sea 1·040, while the Dead Sea has the high specific gravity of 1·250.



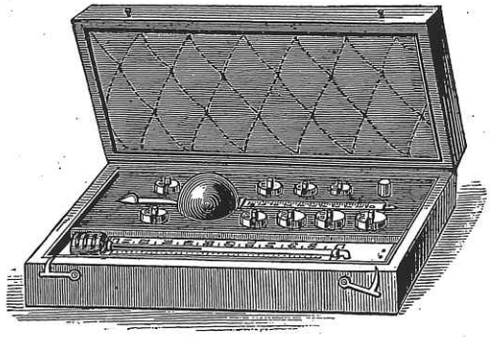
208.
SCALE ABOUT 1-4TH.

SIKES' HYDROMETER.

This is the form of Hydrometer adopted by the Department of Inland Revenue for the collection of the duty on spirits. It is made of brass, the joints of which are silver soldered, the whole being strongly electro-gilt. It consists of a hollow sphere, having a straight upper stem, marked from 1 to 10, each principal division being subdivided into five parts. The stem below the globe is conical and loaded with a pear-shaped bulb. There are nine moveable circular weights, numbered from 10 to 90; a slot in each of these admits of its being slid on to the small part of the conical stem, when it glides down to the bulb, where it becomes fixed. The instrument floats at 0 or zero in strong spirit, specific gravity ·825, and, consequently, in weaker spirit containing more water, weights are added to make it sink. The number engraved on each weight indicates so many principal divisions of the stem:—*e.g.*, the heaviest weight marked 90, being equal to ninety divisions, will, if added, make the instrument float at 0 in distilled water, and as each principal division includes five sub-divisions, a range of 500° is embraced between water and standard alcohol, specific gravity ·825.

On the side face of the stem, near division 1, is a mark at which the instrument with weight 60 will float in proof spirit at a temperature of 51° Fahr., and if the small cylindrical or rectangular weight be placed on the top of the stem, the weight 60 still resting on the bulb, the instrument will float at the same mark in distilled water at the same temperature.

The cylindrical weight is exactly 1-12th of the total weight of the Hydrometer and the weight 60, the indications described, therefore, are in conformity with the definition of proof spirit in the Act of Parliament, which requires, "Proof spirit to weigh at 51° Fahrenheit, exactly 12-13th parts of an equal bulk of distilled water."

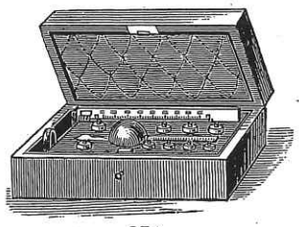


209.

SCALE ABOUT 1-4TH.

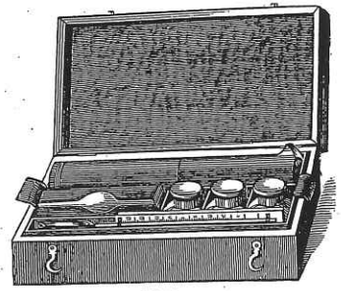
SIKES' HYDROMETERS.

	£	s.	d.
596. **Sikes' Hydrometer** with 7-in. ivory scale Thermometer, in mahogany box, book of tables, directions, and trial glass, complete (Fig. 209)	2	12	6
597. **Sikes' Hydrometer**, strongly electro-gilt, best ivory Thermometer, in mahogany box, book of tables, directions and trial glass, complete	3	0	0
598. **Sikes' Hydrometer**, silver-soldered, strongly electro-gilt, 9-in. ivory scale Thermometer, enamel tube, in mahogany box, velvet-lined, book of tables and directions, comparative rule and trial glass, complete . . .	3	10	0
599. **Sikes' Hydrometer**, strongly electro-gilt, 9-in. ivory scale, enamel tube Thermometer, magnifying glass in best mahogany box, with book of tables and directions, comparative rule and trial glass, complete (Fig. 208) .	3	15	0
600. **Sikes' Hydrometer** (Standard), silver-soldered, strongly electro-gilt, with open scale, enamel tube Thermometer, divided on stem with Kew verification, in mahogany box, with book of tables and directions, comparative rule and trial glass, complete	4	10	0
601. **Sikes' Hydrometer**, small pocket size, suited for merchants desirous of testing small samples, silver-soldered, strongly electro-gilt, with small ivory reducing rule, ivory scale, enamel tube Thermometer, magnifying glass, small book of tables and directions, and trial glass, in polished walnut or rosewood case (Fig. 210) .	4	10	0
602. **Sikes' Hydrometer**, silver-soldered, strongly electro-gilt, ivory reducing and valuing rule, ivory proof rule, ivory scale, enamel tube Thermometer, in mahogany box, with tables, directions and trial glass, complete .	4	10	0
603. **Sikes' Hydrometer**, same as preceding, with ivory reducing and valuing rule, ivory Thermometer, enamel tube, &c.	4	0	0



210.

SCALE ABOUT 1-5TH.



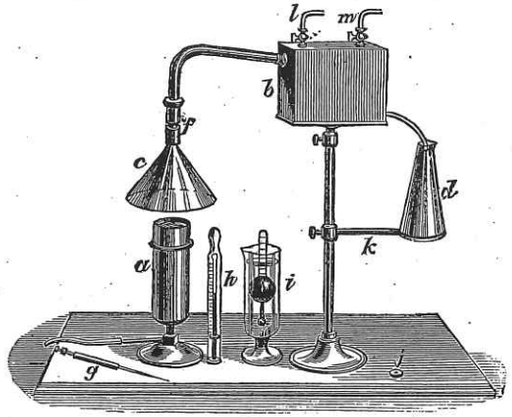
211.

SCALE ABOUT 1-4TH.

SIKES' HYDROMETER.

	£	s.	d.
604. **Sikes' Hydrometer**, silver-soldered, strongly electro-gilt, reducing and valuing rule, boxwood proof rule, ivory scale, enamel tube Thermometer, in mahogany box, with book of tables, directions and trial glass, complete	4	0	0
605. **Sikes' Hydrometer**, boxwood reducing and valuing rule, ivory scale, enamel Thermometer, as preceding .	3	15	0
606. **Sikes' Hydrometer**, silver-soldered, strongly-electro-gilt, boxwood reducing and valuing rule, boxwood proof rule, best ivory scale Thermometer in ordinary mahogany box, with tables, directions and trial glass .	3	5	0
607. **Sikes' Hydrometer**, for Warm Climates, as supplied to the Indian Government, is made only to order, and furnished with Tables calculated for 100° FAHRENHEIT.			

The price for either of the above, adapted for warm climates, is 5/- extra each.



212.

SCALE ABOUT

WINE TESTING APPARATUS.

608. This apparatus (Fig. 212) is arranged for conveniently determining the amount of proof spirit in wines, liqueurs, &c., and is employed in the laboratories of H. M. Board of Customs. It includes one each chemical Thermometer, measure, trial jar and bottle, 12 feet flexible tube and 12 flexible washers. £5 5 0

TWADDLE'S HYDROMETERS

Are used for testing the strength of liquids which vary but slightly in specific gravity, and, therefore, require an extended or open scale. Accordingly, the instruments are sold in sets of six, the whole scale, from 0°, or water, to 170°, being extended through the entire series of six stems, of about six inches in length, and including a range of specific gravities varying from water, represented as 0° on scale No. 1, to 170° on scale No. 6, which, as each degree is equal to five grains of specific gravity, represents the strength of oil of vitriol, or a specific gravity of 1·850.

To convert degrees of Twaddle into specific gravity, multiply by 5, and add 1·000.

	£	s.	d.
609. **Twaddle's Hydrometers**, Nos. 1 to 3 . . each	0	2	6
610. **Twaddle's Hydrometers**, Nos. 4 to 6 . . each	0	3	0
611. **Twaddle's Hydrometers**, from 1 to 6, of standard excellence	0	4	6
612. **Twaddle's Hydrometers**, set of six, in stained deal case	1	5	0
613. **Twaddle's Hydrometers**, set of six, in mahogany case, with Thermometer, divided and figured on stem, for immersion in acids, &c.	1	15	0

614. **Twaddle's Hydrometers**, adjusted to 84° Fahrenheit, for the West Indies, 6d. each extra.

No. 1	...	0 to 25	...	Sp. Gr. 1·000 to 1·125
,, 2	...	25 to 50	...	Sp. Gr. 1·125 to 1·250
,, 3	...	50 to 75	...	Sp. Gr. 1·250 to 1·375
,, 4	...	75 to 100	...	Sp. Gr. 1·375 to 1·500
,, 5	...	100 to 125	...	Sp. Gr. 1·500 to 1·675
,, 6	...	135 to 170	...	Sp. Gr. 1·674 to 1·850

615. **Fahrenheit's Hydrometer** resembles an ordinary Hydrometer, except that the upper bulb is larger, and the stem terminates in a cup at the top. £0 10 6

A mark about the middle of the stem is the point at which the Hydrometer should float when the requisite weights are put into the cup. It resembles NICHOLSON'S Gravimeter in its mode of action.

This instrument is, however, specially adapted for taking the specific gravity of solids in the following manner: The mineral, metal, or other solid is placed in the upper cup, with weights sufficient to sink the Hydrometer to the mark on the stem; this yields the weight of the body *in air*. The mineral is then placed in the lower cup, and the weights adjusted, until the instrument floats at the same mark on the stem, thus yielding the weight of the body in water. From these data the specific gravity is calculated in the usual manner.

	£	s.	d.
616. **Nicholson's Gravimeter**, in strongly-gilt metal, in mahogany case, with divisions (Fig. 200) . .	2	2	0
617. **Nicholson's Gravimeter**, in brass, in mahogany case, with divisions	1	17	6
618. **Nicholson's Gravimeter**, in japanned tin . .	0	7	6

SACCHAROMETERS.

These instruments are a modification of the Hydrometer, adapted specially for the use of brewers, distillers, &c., to show the gravity or increased weight of the wort or other liquor, in the proportion of pounds and half-pounds to the barrel; adopting as a standard of comparison the weight of a barrel of water, viz., 360lbs. It is adjusted at a temperature of 60°, and if the wort is at that temperature when tested, the instrument will give an exact indication of its gravity; but as the wort is generally at a much higher temperature, a table of corrections is furnished with each instrument, showing the number of pounds to be added to the indications of the Saccharometer at any temperature up to 150° FAHRENHEIT.

	£	s.	d.
618a. **Hicks' Patent Enamel Stem Saccharometer** (Fig. 203)	0	5	0
619. **The Brewer's Saccharometer**, with paper scale .	0	3	6
620. **Glass Saccharometer**, ivory scale, metal case .	0	4	0
621. **Glass Saccharometer**, ivory scale, with trial glass, in mahogany case	0	8	6
622. **Glass Saccharometer** do. do. and Thermometer do.	0	15	6
623. **Improved Brewing Saccharometer**, in strongly gilt metal, for use with one weight, in velvet-lined mahogany case, with Thermometer, rule and instructions .	4	4	0
624. **Improved Brewing Saccharometer**, electro-gilt, same as above, with one weight, in mahogany case .	3	3	0
625. **Saccharometer**, in strongly electro-gilt metal, one weight, divided to 1-5th of lb., stout Thermometer, slide rule, with directions, in mahogany case	4	4	0
626. **Bates's Patent Saccharometer**, in strongly gilt metal, with five weights for giving the value of wort, low wines, &c., in direct specific gravity degrees. In velvet-lined mahogany case, with gilt Thermometer, tables and instructions	5	5	0
627. **Allan's Saccharometer**, joints silver-soldered, strongly electro-gilt, metal scale Thermometer, ivory rule, in mahogany box, complete	4	4	0
628. **Dicas' Saccharometer**, strongly electro-gilt, eighteen weights and book, in box, complete . . (to order)			
629. **Dicas' Improved Saccharometer**, nine weights in box, complete	5	5	0
630. **Saccharometer**, best double gilt, divided on three sides of stem, two weights, showing from water to 60 lb. per barrel, Thermometer and rule in box, complete . .	4	4	0
631. **Standard Saccharometer**, including two strongly electro-gilt Saccharometers, one ranging from 0 to 30 lbs., and the other from 30 lbs. to 60 lbs., divided into tenths of a pound, one weight and best Thermometer, complete .	6	6	0
632. **Richardson's Saccharometer**, in electro-gilt metal, to 60 lbs., in mahogany case	4	4	0
633. **Soleil's Saccharometer**, modified by DUBOSCQ, for estimating the value of saccharine fluids by polarized light. This is an instrument of extreme delicacy and precision, where accuracy is required, as in analytical examinations. Full directions for use are supplied with each instrument	16	16	0

HICKS' PATENT URINOMETER.

The Urinometer indicates the departure of urine from its healthy, normal standard. One side of the scale is marked with degrees, and the reverse side with the following letters:—W, showing the point at which the instrument rests when immersed in pure water; H, the point for healthy, normal urine; S, indicating an increase of strength, or specific gravity, but a diminution of health; the last division showing the point at which the disorder known as "Diabetes" has set in, its *progress* is indicated by the instrument floating at lower divisions of the scale.

	£	s.	d.
634. **Hicks' Patent Urinometer** is an elegant and superior form of instrument, which is figured and divided in *black* on the *white* enamel stem itself, thus avoiding all errors arising from shifting of scale, as with paper and ivory; corrosion, as with metal, or alteration of form as with vulcanite. In pull off leather case (Fig. 204) . . each	0	5	0
635. **Prout's Urinometer**, ivory scale, leather case (Fig. 205)	0	3	6
636. **Prout's Urinometer**, ivory scale and graduated trial glass, in double pull-off leather case	0	5	6
637. **Prout's Urinometer**, ivory scale, graduated trial glass, and test papers in hinged morocco case with snap	0	7	6
638. **Prout's Urinometer**, &c., same as preceding, ivory scale and Thermometer	0	12	6
639. **Urinary Cabinet** containing Urinometer, Thermometer, spirit lamp, two small bottles, test tubes, pipette, graduated trial glass and test papers	0	17	6
640. **Urinary Cabinet**, containing Urinometer graduated trial glass, Thermometer, spirit lamp, three small bottles, test tubes, pipette and test papers (Fig. 211) . . .	1	1	0
641. **Highley's Urinary Cabinet**, containing Urinometer, graduated trial glass, Thermometer, spirit lamp, three cut glass bottles, test tubes, pipette and test papers . .	1	10	0
642. **Improved Urinary Test Stand**, including seven 1-oz. bottles with appropriate reagents; Urinometer trial glass, Chalk's drop bottle, 2-oz. glass spirit lamp, microscopic slides and thin glass pipette, watch glasses, stirring rod, platinum foil and wire, blowpipe, brass forceps, test tubes and test tube holder, turmeric paper and red and blue litmus paper, Thermometer and Stanhope lens .	2	5	0
643. **Beale's Urinometer Clinical Cabinet**, containing ivory scale Urinometer in pull-off leather case, graduated glass trial jar, glass pipette test tubes, stirring rods, watch glasses, strips of glass, thin microscope glass covers, glass spirit lamp, test papers, test tube holder, divisions for seven improved capped dropping bottles, to contain acetic acid, nitric acid, ammonia, potash, barytic nitrate, argentic nitrate and ammoniacal oxalate . .	2	2	0
644. **Urinometer**, electro-gilt metal, in leather case . .	0	10	6
645. **Urinometer** in eletro-gilt metal, graduated trial glass, in double pull-off case	0	12	6

Either of the above sets with HICKS' Patent Urinometer, 1/6 each extra.

SPECIFIC GRAVITY BOTTLES.

	£	s.	d.
646. **Specific Gravity Bottle**, to 1000 grains, with counterpoise, in japanned metal case	0	7	6
647. **Specific Gravity Bottle**, to 500 grains, with counterpoise, in japanned metal case	0	6	6
648. ***Specific Gravity Bottle**, to 250 grains, with counterpoise, in japanned metal case	0	5	6

SP. GR. BEADS, OR SPIRIT BUBBLES.

These are hollow globes of glass, about the size of pistol bullets, each of which, being adjusted to a particular degree of SIKES's Hydrometer, becomes a Hydrometer, and, by floating half-way between the top and bottom of the liquid in which it is immersed, shows that liquid to be of the specific gravity marked on the bead.

649. **Specific Gravity Beads**, set of 12 in box, with tables indicating strengths 45 over proof and 60 under proof (Fig. 213)	0	7	6
650. **Sepcific Gravity Beads**, set of 18 in box, with tables indicating strengths 63 over proof and 75 under proof .	0	10	6
651. **Specific Gravity Beads**, set of 24 in box, with tables indicating strengths from water to 60 over proof . .	0	15	6

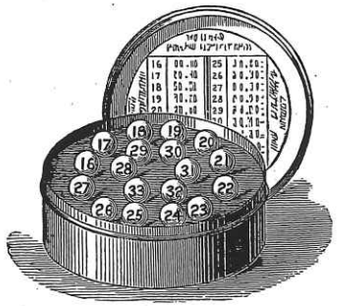
SALINOMETERS.

The Salinometer is a modification of the Hydrometer, with a special scale, adapting it to ascertain the density of water in marine steam boilers. The zero of the scale marked O represents the point to which the instrument sinks in pure water, at a temperature of 200° FAHRENHEIT, the other divisions are marked 1-32nd, 2-32nds, 3-32nds and 4-32nds, each division indicating that the liquid contains one, two, three, or four parts of saline matter in 32 parts of water.

Midway between 2-32nds and 3-32nds the word "Blow" is engraved, to indicate that at that density the boiler water should be blown off and replaced by fresh water, to prevent incrustation. The temperature for testing the water is 200° FAHRENHEIT, a point to which it readily cools during the process of pouring into the stout copper testing pot, which should be purchased with each instrument.

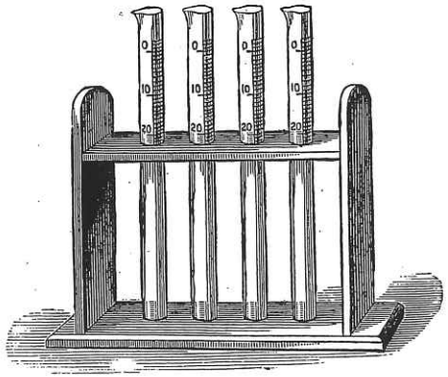
652. **Salinometer** of glass, in metal case	0	3	6
653. **Salinometer** of gilt metal, in metal case . . .	0	10	6
654. **Salinometer**, strongly gilt do. . . .	0	12	6
655. **Salinometer** of gilt metal, in velvet-lined mahogany case each	0	15	6
656. **Salinometer**, strongly gilt do. . . ,,	0	17	6
657. **Salinometer** of German silver, in velvet-lined mahogany case ,,	0	16	6
658. **Salinometer** of German silver with Thermometer, in velvet-lined mahogany case	1	5	0
659. **Salinometer Thermometer**	0	5	6
660. **Salinometer Testing Pot**, stout copper, with division	0	8	6

* Without Counterpoise, each 6d. less.



213.

SCALE ABOUT



214.

SCALE ABOUT

LACTOMETERS

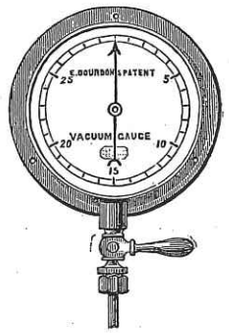
Are Milk-Testers, constructed on the principle of the Hydrometer, with a bulb and graduated stem, which is immersed in the milk to be tested. The mark on the scale, nearest the surface of the milk, shows the amount of adulteration, if any; and, in the best forms, the scale is divided from 0 to 35 grains of specific gravity on one side, and into four parts on the other, each line representing water, three quarters water, half water, one quarter water, and pure milk.

In the second quality, the following scale is used:—W, being water; 1, being equal to one part milk and three parts water; 2, indicating equal parts of pure milk and water; 3, showing three parts milk to one part water; and M, being the division at which the instrument floats in pure milk.

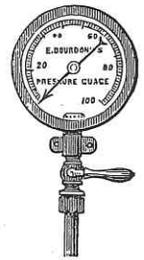
The white opal-glass stem with black figures, which forms so invaluable a modification of the Hydrometer, Salinometer, &c., renders HICKS' Patent Lactometer simply perfect, as the milk-like stem when in use becomes almost invisible, while the black figures become intensely distinct in the white fluid.

	£	s. Each.	d.
661. **Hicks' Patent Lactometer**	0	5	0
662. **Hicks' Patent Lactometer** with jar and pull off case	0	7	6
663. **Lactometer** (best) with ivory scale, in pull-off case .	0	2	6
664. **Lactometer**, ivory scale, with jar and pull-off cases .	0	4	0
665. **Lactometer** with paper scale	0	1	0
666. **Lactometer** with glass jar, in double pull-off case .	0	2	0
667. **Lactometer Tubes** on glass foot	0	4	0
668. *__Comparative Lactometer__, consisting of a set of four graduated 10-in. tubes, on mahogany stand (Fig. 214)	0	10	6
669. **Comparative Lactometer** with six 10-in. tubes .	0	15	6

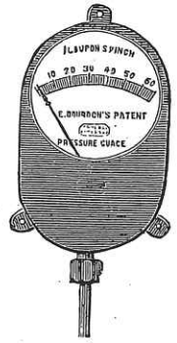
* These Tubes are graduated in the upper portion only, to admit of a comparison of suspected samples of milk with a pure standard, by showing the number of divisions filled by the fatty butter globules after the samples have been allowed to remain undisturbed for a stated time.



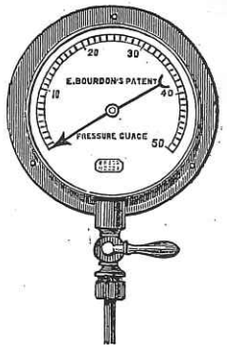
215.



216.



217.

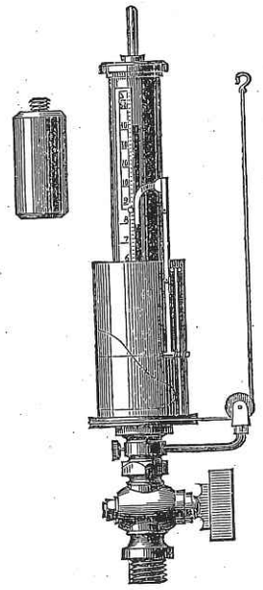


218.

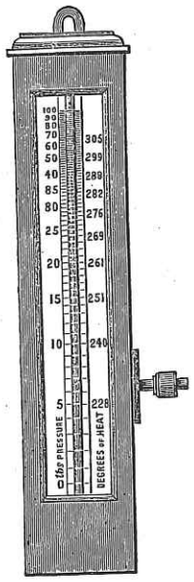
BOURDON'S
PATENT PRESSURE AND VACUUM GAUGES.

These Gauges are guaranteed by the manufacturer for two years, provided the Instructions sent with the instruments are observed in fixing them.

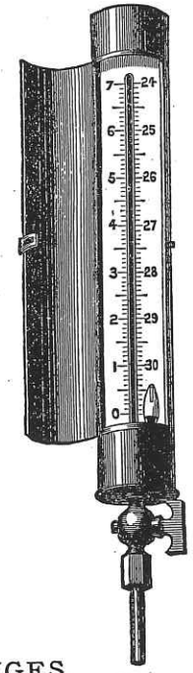
	£	s.	d.
670. **Pressure Gauge**, in oblong case of japanned iron, with enamelled dial to indicate up to 60, 80, 100, 150, 200 or 250lbs. upon the square inch, with connecting screw joint (Fig. 217).	1	12	6
671. **Pressure Gauge**, in round case of polished brass, 7-in. diameter, with eccentric hand to indicate 50, 60, 80, 100, 150, 200 or 250lbs. upon the square inch, fitted with gun metal cock	2	5	0
672. **Pressure Gauge**, in round case of polished brass, 7-in. diameter, with central hand to indicate 10, 20, 25, 30, 35, 40, 50, 60, 80, 100, 150, 200 or 250lbs. upon the square inch, fitted with gun metal cock (Fig. 218). .	2	10	0
673. **Vacuum Gauge**, in round case of polished brass, 7-in. diameter, with central hand to indicate vacuum to 30 inches of mercury, with gun metal cock (Fig. 215).	2	12	6
674. **Pressure Gauge**, in round case of polished brass, 5-in. diameter, with eccentric hand to indicate 60, 80, 100, 150, 200 and 250lbs. upon the square inch, fitted with gun metal cock	1	15	0
675. **Pressure Gauge**, in round case of polished brass, 5-in. diameter, with central hand to indicate 30, 40, 60, 80, 100 or 150lbs. upon the square inch, fitted with gun metal cock (Fig. 216).	1	17	6
676. **Pressure Gauge**, in round case of polished brass, 4-in. diameter, with eccentric hand to indicate 60, 100 or 150lbs. upon the square inch, fitted with gun metal cock.	1	12	6
677. **Pressure Gauge**, as preceding, without cock but with iron syphon	1	8	0
678. **Pressure Gauge**, as preceding, with connecting screw joint	1	7	6



219.



220.

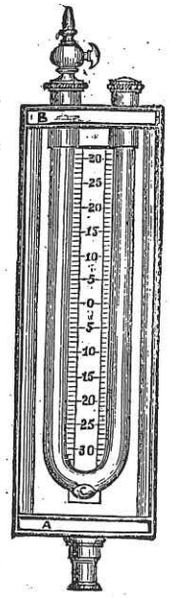


221.

Scale about

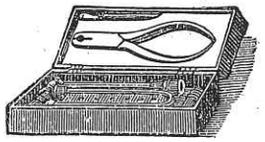
PRESSURE AND VACUUM GAUGES.

	£	s.	d.
679. **Mercurial Pressure Gauge**, in mahogany case, 25-in. by 5-in., strong union joint to indicate pressures from 30 lbs. to 300 lbs. per square inch. (Fig. 220) .	2	0	0
680. **Mercurial Vacuum Gauge**, scale from 24 to 31 inches, round brass case, with stop-cock, door, &c. (Fig. 221) .	1	15	0
680a. **Mercurial Vacuum Gauge**, as preceding, with scale from 14-in. to 31-in.	1	18	0
681. **Improved Steam Engine Indicator**, adapted for high and low pressures, for accurately registering the speed of engines, in mahogany case, with ivory scale and steel tap (Fig. 219)	5	10	0
682. **Hicks' New Patent Gas Gauge.** These gauges are divided and figured on the tube, which has a white enamelled back-ground, against which, the pressure of the gas can be read with great facility, on mahogany board with fittings, 12-in., 23/6; 14-in., 25/-; 16-in., 27/6; 18-in., 30/-; 20-in., 32/6; 24-in., 36/-; 30-in. .	2	2	0
683. **Gas Pressure Gauges**, porcelain scales and slabs (Fig. 225), with facilities for cleansing without unfixing flanges at back for fixing, all undue strain upon the porcelain being avoided, 12-in., 23/6; 18-in., 30/-; 24-in. .	1	15	0
684. **Pressure Gauges**, boxwood scales, 3-in., 3/-; 4-in., 3/6; 5-in., 4/-; 6-in., 4/6; 8-in., 5/-; 10-in., 5/6; 12-in.	0	6	0
685. **Pressure Gauges**, ivory scales, boxwood back, 3-in., 5/-; 4-in., 5/6; 5-in., 6/-; 6-in., 6/6; 8-in., 7/-; 12-in.	0	12	6
686. **Pressure Gauges**, ivory scale front and back, 3-in., 5/6; 4-in., 6/-; 5-in., 6/6; 6-in., 7/6; 7-in., 8/6; 8-in. .	0	9	6



222.

Scale about 1-4th.



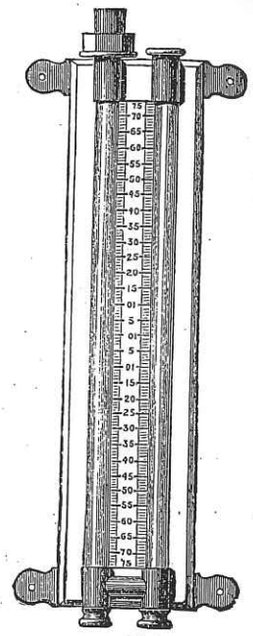
223.

Scale about 1-4th.



224.

Scale about 1-4th.



225.

Scale about 1-4th.

GAS PRESSURE GAUGES.

	£	s.	d.
687. **Pressure Gauges**, large glass tube, boxwood scale, mounted on polished mahogany board, no brass fittings, tube like Fig. 222, 12-in., 10/6; 14-in., 11/6; 16-in., 12/6; 18-in., 13/6; 20-in., 15/6; 24-in., 17/6; 30-in., 25/-; 36-in.	1	15	0
688. **Pressure Gauges**, large glass tube, boxwood scale, on mahogany board, brass mounted top, with union and cap, brass socket, with plugs at bottom to facilitate cleansing without unfixing the gauges, 12-in. 21/-; 18-in. 25/-; 24-in. 35/-; 36-in.	2	0	0
689. **Protective Pressure Gauges**, glasses and scales fitted in a metal case, to adapt them for exposed situations. Provision is made for the easy replacement of broken tubes. Smaller gauges have open fronts. 12-inch and larger, doors on front. Ivory scales on boxwood, 6-in., 10/6; 8-in., 12/6; 10-in., 17/6; 12-in. (Fig. 222).	1	1	0
690. **Protective Pressure Gauges**, boxwood scales, 6-in., 4/6; 8-in., 5/6; 10-in., 6/6; 12-in., 8/6; 24-in., 11/6; 30-in.	0	17	6
691. **Pocket Gauge**, for inspectors and private use, 3-in. scale mounted in brass, special joint to prevent escape of water when in the case, swivels to allow scale being vertical while gauge is attached to pipe, sockets with inside and outside screws, steel plyers and burner broach, in morocco case. (Fig. 223)	1	0	0
692. **Pocket Gauge**, 4-in. scale, tube, plyers and two T's, to enable gauge to determine pressure at which burners consume gas, in morocco case	1	5	0

Prices for 684, 685, 686, 687 and 690 are for glass tubes and scales only.

By Her Majesty's Royal Letters Patent

Patent Number 4111.—1874.

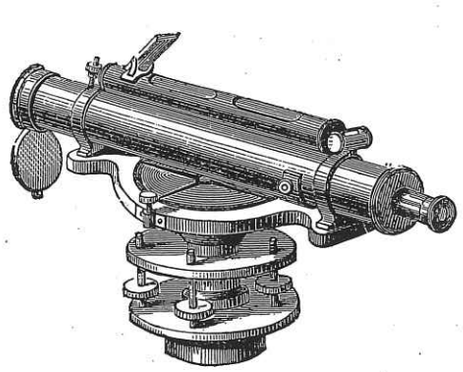
692a. CROSSLEY, HANSON & HICKS' PATENT ENAMELLED WATER GAUGE GLASSES FOR STEAM BOILERS.

"The height of the water can always be seen at a great distance and in dark situations, it can also be seen at a glance whether the water is above the top or down below the bottom of the gauge." The absence of this facility of observation is a serious defect with Plain Tubes or Gauge Glasses, in which it is almost impossible to ascertain whether the boiler is full of water or otherwise. This defect is a frequent cause of boiler explosions.

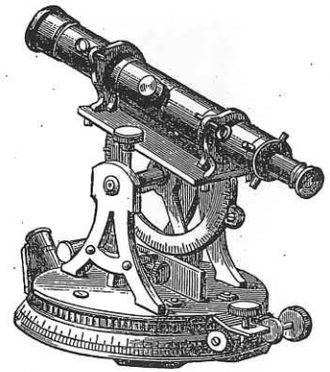
The water in these Patent Tubes is reflected from a white enamelled back ground, showing the water white as milk, and thus producing the results described above.

Inches.	Per Doz.	Inches.	Per Doz.	Inches.	Per Doz.	Inches.	Per Doz.	Inches.	Per Doz.
12	⅜... 8/9	12	⅝...10/6	12	¾...12/0	12	⅞...13/0	12×1	...14/8
13	⅜... 9/3	13	⅝...11/0	13	¾...12/6	13	⅞...14/0	13×1	...16/0
14	⅜... 9/9	14	⅝...11/6	14	¾...13/0	14	⅞...15/2	14×1	...17/3
15	⅜...10/3	15	⅝...12/0	15	¾...13/6	15	⅞...16/2	15×1	...18/6
16	⅜...10/9	16	⅝...12/6	16	¾...14/0	16	⅞...17/2	16×1	...19/3
17	⅜...11/3	17	⅝...13/0	17	¾...14/8	17	⅞...18/3	17×1	...21/0
18	⅜...11/9	18	⅝...14/0	18	¾...15/2	18	⅞...19/3	18×1	...22/3
19	⅜...12/3	19	⅝...15/0	19	¾...16/2	19	⅞...20/3	19×1	...23/6
20	⅜...12/9	20	⅝...15/8	20	¾...17/2	20	⅞...21/3	20×1	...25/0
21	⅜...13/3	21	⅝...16/2	21	¾...18/3	21	⅞...22/3	21×1	...26/0
22	⅜...13/9	22	⅝...16/8	22	¾...19/3	22	⅞...23/3	22×1	...27/6
23	⅜...14/3	23	⅝...17/2	23	¾...20/3	23	⅞...24/3	23×1	...28/6
24	⅜...14/9	24	⅝...17/8	24	¾...21/3	24	⅞...25/6	24×1	...29/6

½ and 9/16 same price as ⅝.



226. SCALE ABOUT 1-6th.



227.

SURVEYING INSTRUMENTS.

THEODOLITES.

693. Theodolite, with all modern improvements, scale reading to one minute, divided on silver, in mahogany case, with tripod stand. (Fig. 227.) *

3-inch. £18.	4-inch. £19.	4-inch. 2 Telescopes. £24.	5-inch. £22.	5-inch. 2 Telescopes. £27.	6-inch. £28.	6-inch. 2 Telescopes. £34.	7-inch. £35.	7-inch. 2 extra large Telescopes. £44.

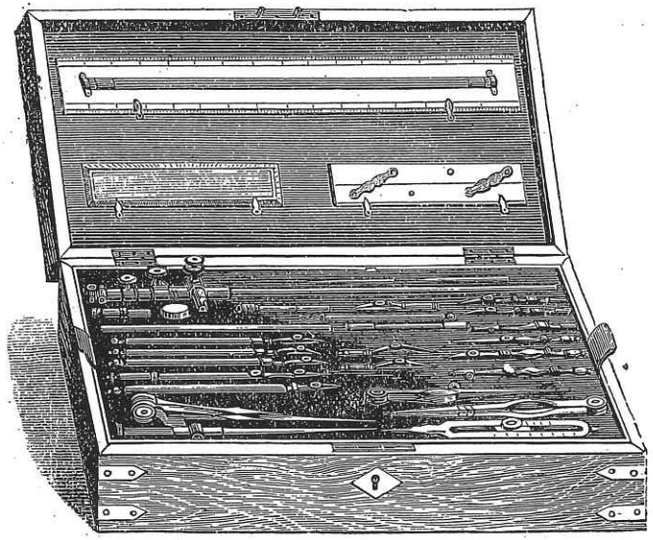
	£	s.	d.
694. **Transit Theodolite**, 4-in. silver circle, engine-divided, with verniers reading to one minute, locking plate, &c., in mahogany case and tripod stand, complete	25	0	0
695. **Transit Theodolite**, 5-in., same as preceding	29	0	0
696. **Transit Theodolite**, 6-in., having transit axis and vertical circle, in addition to appliances in No. 694	34	0	0
697. **Transit Theodolite**, 7-in., very complete, with transit axis and vertical circle, &c.	43	0	0
698. **Transit Theodolite**, 8-in., as preceding	51	0	0
699. **Transit Theodolite**, 12-in., for horizontal angles only	40	0	0
700. **Everest's Theodolite**, 4-in., £19; 5-in., £22; 6-in. £26; 7-in.	35	0	0

GRAVATT'S DUMPY LEVELS.

	£	s.	d.
701. **Gravatt's or Dumpy Level**, with tripod stand, &c., complete, 10-in., £13; 12-in., £13 10/-; 14-in., £14; 16-in. (Fig. 226)	15	0	0
702. **Troughton's Level**, 14-in., £11 10/-; 20-in.	13	0	0
703. **Drainage Level** (best form)	5	0	0
704. **Drainage Level** (plain sights)	2	8	0
705. **Drainage Level**	1	5	0
706. **Brass Pocket Levels**, with adjusting screws, 4-in., 7/6; 6-in., 10/6; 8-in., 13/6; 10-in., 18/-; 12-in.	1	5	0
707. **Spirit Levels**, mahogany frames, brass plates, 6-in., 3/-; 8-in., 3/8; 10-in., 4/6; 12-in.	0	5	6

Either of the above GRAVATT'S Levels, without compass, 30/- less.

* Locking plates, extra 3-in., 21/-; 4-in., 30/-; 5-in., 45/-; 6-in., 60/-; 7-in., 75/-



228.
SCALE ABOUT

DRAWING INSTRUMENTS.

	£	s.	d.
708. Brass Sector-joint Dividers, 4-in., 3/-; 5-in., 3/-; 6-in.	0	3	6
709. Brass Sector-joint Dividers, superior 4-in., 4/-; 5-in., 4/-; 6-in.	0	4	6
710. Brass Hair-point Dividers, 4-in. or 5-in. (Fig. 232).	0	5	0
711. Brass Hair-point Dividers, superior 4-in. or 5-in.	0	6	0
712. Electrum Sector-joint Dividers, 4-in. or 5-in., 4/-; 6-in.	0	4	6
713. Electrum Sector-joint Dividers, superior 4-in. or 5-in., 4/6; 6-in.	0	6	0
714. Electrum Hair-point Dividers, 4-in. or 5-in.	0	7	0
715. Electrum Hair-point Dividers, superior quality, 4-in. or 5-in.	0	8	0
716. Lift-up Nib Brass Pens, 4½-in. or 6-in.	0	2	0
717. Lift-up Nib Brass Pens, superior quality, 4½-in. or 6-in.	0	3	0
718. Lift-up Electrum Nib Pens, 4½-in. or 6-in.	0	3	0
719. Lift-up Electrum Nib Pens, superior quality, 4½-in. or 6-in.	0	4	0
720. Steel Ivory-handle Pens, 4½-in. or 6-in., 1/9 to	0	2	0
721. Steel Ivory-handle Pens, superior quality, 4½-in. or 6-in. 2/6 to	0	3	0
722. Road Pen (Fig. 234) 5/-, 7/- and	0	10	0
723. Wheel Pen (Fig. 235) 4/- and	0	5	6
724. Wheel Pen, with set of four wheels, in box 7/6 and	0	8	6
725. Selected Sets of Instruments, with scales, &c., complete, leather, walnut, mahogany or rosewood cases, from 30/- to (Fig. 228)	30	0	0



229.



230.

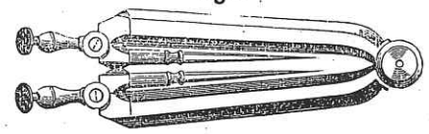


231.



232.





233.



234.





236.
SCALE ABOUT ½.

235.
SCALE ABOUT ½.

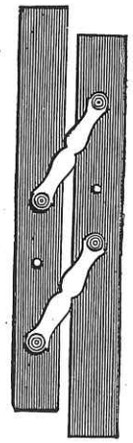
237.
SCALE ABOUT ½.

DRAWING INSTRUMENTS.

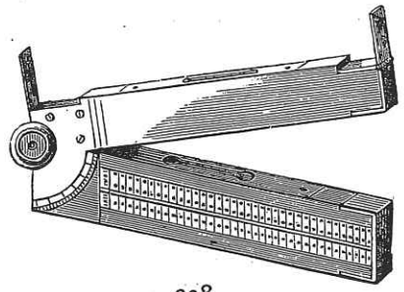
	£	s.	d.
726. Needle Holder (Fig. 231), 1/9, 2/-, and	0	2	6
727. Bordering Pen, for broad lines, 5/6 and	0	6	0
728. Ink and Pencil Bows, plain brass, 4½-in. or 6-in., 2/-	0	2	6
729. Ink and Pencil Bows, ditto, superior quality, 4½-in. or 6-in., 3/6 and	0	4	0
730. Ink and Pencil Bows, double jointed brass, 4½-in. or 6-in.	0	7	0
731. Ink and Pencil Bows, ditto, superior quality, 4½-in. or 6-in.	0	8	0
732. Ink and Pencil Bows, needle-pointed, brass, 4½-in. or 6-in. (Fig. 236)	0	7	6
733. Ink and Pencil Bows, ditto, superior quality, 4½-in. or 6-in. (Fig. 237)	0	8	6
734. Ink and Pencil Bows, electrum, 4½-in. or 6-in.	0	4	0
735. Ink and Pencil Bows, ditto, superior quality, 4½-in. or 6-in.	0	5	6
736. Ink and Pencil Bows, double-jointed, electrum, 4½-in. or 6-in., 6/6, 8/6, and	0	9	6
737. Ink and Pencil Bows, needle-pointed, electrum, 4½-in. or 6-in., 8/- and	0	9	0
738. Ink and Pencil Bows, ditto, superior quality, 4½-in. or 6in.	0	10	6
739. Set of Plain Spring Bows, in case, 6/6 and	0	7	6
740. Set of Plain Spring Bows, superior quality, 11/6 and	0	13	6
741. Set of Needle Spring Bows, in case, 10/6 and	0	15	0
742. Set of Needle Spring Bows, superior quality	1	1	0

COMPASSES.

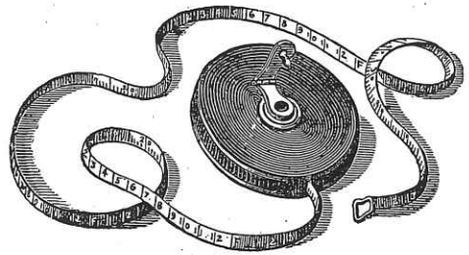
	£	s.	d.
743. **Triangular Compasses**, 5-in., 12/6; 6-in. . .	0	13	6
744. **Triangular Compasses**, superior quality, 5-in., 15/-; 6-in.	0	16	6
745. **Bisecting Compasses**, superior quality . . .	0	18	6
746. **Proportional Compasses**, fully divided electrum, in case, 6-in. (Fig. 229) 27/6 and	1	10	0
747. **Tubular Compasses**, best electrum, improved solid slides and plain steel points, in case	1	15	0
748. **Beam Compass Heads**, electrum, to fit on straight-edge, plain steel points 10/6, 12/6 and	0	15	6
749. **Beam Compass Heads**, ditto, with screw adjustment 12/6, 15/6 and	0	17	6
750. **Beam Compass Heads**, ditto, ditto, and points to hold needles 15/6, 17/6 and	1	1	0
751. **Pillar Compasses**, electrum, in case . 17/6 and	1	1	0
752. **Napier Compasses**, electrum, in case . 21/- and	1	7	6
753. **Sector-joint Compasses**, brass, with ink and pencil points, 4½-in. or 6-in.	0	8	6
754. **Sector-joint Compasses**, ditto, superior quality .	0	10	6
755. **Sector-joint Compasses**, brass, with ink and pencil points and bar, 4½-in. or 6-in.	0	10	6
756. **Sector-joint Compasses**, ditto, superior quality .	0	12	6
757. **Sector-joint Compasses**, electrum, with ink and pencil points, 4½-in. or 6-in.	0	11	6
758. **Sector-joint Compasses**, ditto, superior quality .	0	15	0
759. **Sector-joint Compasses**, electrum, with ink and pencil points and bar, 4½-in. or 6-in.	0	15	6
760. **Sector-joint Compasses**, ditto, superior quality .	0	17	6
761. **Double-joint Compasses**, with ink and pencil points and lengthening bar, superior, electrum, 4½-in. or 6-in. 21/- and	1	5	0
762. **Double-joint Compasses**, ditto, with points to hold needles. (Fig. 233) 21/- and	1	10	0
763. **Double-joint Compasses**, with improved needle points, ink and pencil points, and lengthening bar, superior, electrum, 4½-in. or 6-in.	1	15	0
764. **Double-joint Ink or Pencil Bows** with improved needle points, superior electrum	0	11	6
765. **Tubular Compasses** with improved needle points, best electrum, in case	2	2	0
766. **Improved Needle Holder**	0	2	6
767. **Drawing Pen**, of improved construction, superior joints and stiff back nib. (Fig. 230)	0	6	6
768. **Drawing Pins**, superior, in brass and electrum . per doz., 4d. to	0	2	0



239.
SCALE ABOUT ¼.



238.
SCALE ABOUT 1-8th



241.
SCALE ABOUT ¼.



240.
SCALE ABOUT ½.

CLINOMETERS, TAPE MEASURERS, &c.

	£	s.	d.
769. **Clinometer with Two Levels** and sights, inclination scale and scale of fathoms, in case (Fig. 238.) .	1	17	6
770. **Clinometer Level**, as above, with bar-needle compass	2	5	0
771. **Tape Measures** to wind up, in leather cases, with folding handles and best fine linen tape, from 24-ft. to 100-ft., from 5/- to (Fig. 241)	1	1	0
772. **Best Tapes only** (without cases) for the above, from 24-ft. to 100-ft., 2/- to	0	8	6
773. **Tape Measures, Patent Metallic**, in hard leather cases with folding handles, from 24-ft. to 100-ft., 7/6 to	1	1	0
774. **Metallic Tapes only** (without cases) for the above, from 24-ft. to 100-ft., 5/- to	0	15	0
775. **Patent Flexible Steel Tape**, in hard leather case, marked with links, 24 feet to 100 feet 21/- to . . .	2	15	0
776. **Improved Spring Pocket Tape Measures** with linen or electrotyped steel tapes, in brass or German silver cases, with or without stops, 3 to 18-ft. tapes, 5/6 to	1	1	0
777. **Parallel Rules**, ebony rolling plain edges, 9-in., 7/-; 12-in., 8/-; 15-in.	0	10	0
778. **Parallel Rules**, ebony (Fig. 239), 6-in., 6d.; 9-in., 1/6; 12-in., 2/-; 15-in., 2/6; 18-in., 3/-; 21-in., 4/-; 24-in. .	0	5	6
779. **Parallel Rules**, ebony rolling, with brass wheels and divided edges, from 6-in. to 24-in. long . . per inch	0	1	0
780. **Map Measurer**, or **Opisometer**. (Fig. 240), 2/6 to	0	4	6

CIRCUMFERENTERS;
OR,
MINER'S DIALS.

	£	s.	d.
781. **Circumferenter**, 4-in., plain, with divided cover .	5	5	0
782. **Circumferenter**, 5-in. do., with divided cover . .	7	7	0
783. **Circumferenter**, 5-in. do., divided circle with rack-work and vernier to compass	9	0	0
784. **Circumferenter**, 6-in. do., cross levels, folding sights, &c., &c., very complete	10	0	0
785. **Headley's Dial**, 5-in, £11 0 0; 6-in. . . .	13	0	0
786. **Headley's Dial** with telescope, 5-in., £13 0 0; 6-in.	16	0	0
787. **Leane's Dial**, 5-in., £13 0 0; 6-in. . . .	16	0	0

LEVELS.

788. **Y Levels** with tripod stand, in mahogany case, complete, 12-in., £12 0 0; 15-in., £13 0 0; 18-in., £14 0 0; 20-in.*	17	0	0

SURVEYOR'S CROSS.

789. **Surveyor's Cross**, octagonal form . . 10/6 and	0	12	6
790. **Surveyor's Cross**, with compass, divided circle, &c.,	2	10	0
791. **Surveyor's Cross**, with ball and socket joint . .	4	10	0

LEVELLING STAFFS AND OFFSETT RODS.

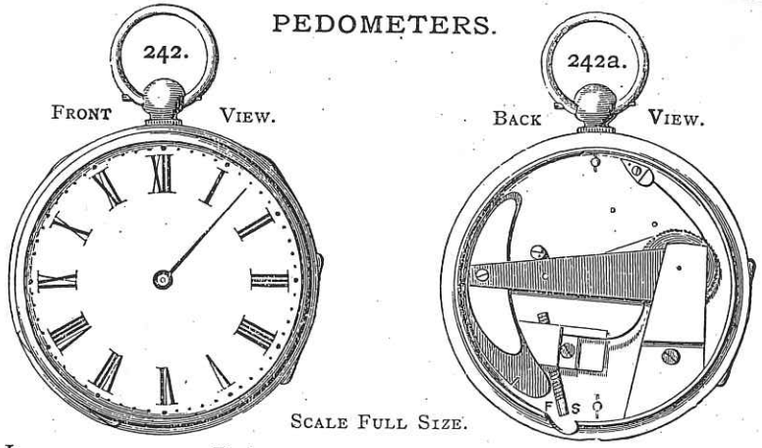
792. **Sopwith's Staff**, 3 joints, painted scale, 12-ft., 40/-; 14-ft., 45/-; 16-ft., 50/-; 18-ft..	2	15	0
793. **Sopwith's Staff**, do., paper scale, each size, less .	0	3	0
794. **Gravatt's Staff**, solid, painted scale 12-ft., 45/-; 14-ft., 55/-; 16-ft., 60/-; 18-ft.	3	7	6
795. **Improved Staff** with painted scale and screws at back, 12-ft., 45/-; 14-ft., 50/-; 16-ft., 65/-; 18-ft. . .	3	10	0
796. **Levelling Staff** with 2 painted scales, 12-ft., 55/-; 14-ft., 65/-; 16-ft., 75/-; 18-ft.	4	4	0
797. **Levelling Staff**, light, for drainage purposes, 8-ft., 35/-; 10-ft.	2	0	0
798. **Offsett Rods**, 6-ft., 36/- per doz.; 8-ft., 45/- per doz.; 10-ft., per doz.	3	3	0
799. **Rods for measuring Standing Timber** (20-ft. in 5-ft. lengths, 25/-;) (do., do., 25-ft. in 5-ft. lengths) .	1	10	0

IRON LAND CHAINS.

800, **Land Chain**, iron, 50-ft. . . . 5/6, 6/6 and	0	8	6
801. **Land Chain**, ditto, 100-ft. . . .8/6, 10/6 and	0	12	6
802. **Gunter's Chain**, 4 poles length	0	10	6
803. **Gunter's Chain**, ditto, best steel wire, hardened, tempered and japanned with oval rings, swivel handles and tallies	0	18	6
804. **Land Chain**, 20 metres length, centimetre links, best make, iron, 10/6; steel	0	18	6
805. **Arrows**, set of 10, iron, 1/- and 1/3; steel, 2/- and	0	3	0
806. **Standard Chain**, 100 feet, iron, 12/6; steel . .	0	18	6
807. **Standard Chain**, 66 feet, iron, 11/6; steel . .	0	17	6
808. **Standard Chain**, 50 feet, iron, 10/6; steel . .	0	12	6

* Locking Plates, each extra, 12-in., 30/-; 15-in., 37/6; 18-in., 45/-; 20-in., 60/-

PEDOMETERS.



SCALE FULL SIZE.

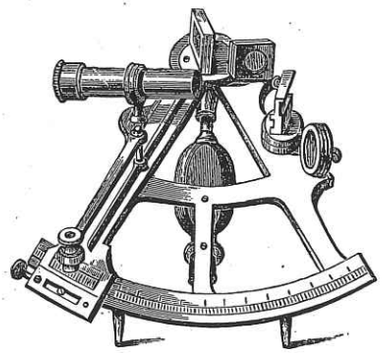
In appearance a Pedometer resembles a watch, and enables the wearer to make accurate measurements of the distance walked. It can be adjusted with facility to long or short steps, and full directions are furnished with each instrument.

	£	s.	d.
809. **Pedometer** in German silver case (Fig. 242) . .	1	15	0
810. **Pedometer** in silver case, with lunette glass . .	2	0	0
811. **Pedometer** in silver case, with crystal glass . .	2	2	0
812. **Pedometer**, silver mounting, crystal back and front	2	2	0
813. **Pedometer**, silver mounting, crystal back and front, nickel-plated works	2	5	0
814. **Pedometer** in silver case, crystal glass and central "set" square, with key	2	5	0
815. **Pedometer** in silver case, crystal glass, tinted dial	2	7	6
816. **Pedometer** in silver case, crystal glass, tinted dial and central "set" square	2	10	0
817. **Pedometer** in silver case, crystal glass, black dial, white figures and "set" square	2	10	0

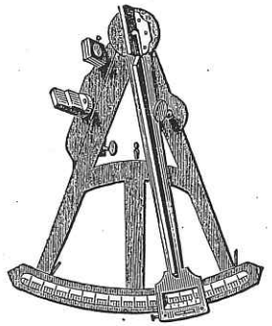
THE PASSOMETER.

The Passometer is for the use of surveyors, Civil and Military engineers, and others, for obtaining an approximate idea of distances by pacing them. The hand on the small dial indicates by a dead beat the number of separate paces up to 50. That on the large dial continues the enumeration up to 2500 and higher. This instrument, prevents the possibility of error through false counting, and precludes that absorbing attention which the counting of any considerable number of paces accurately, requires. A stop, passing through the pendant, puts the instrument in or out of action, at pleasure. Directions for Use.—Shake the instrument until the small hand stands at 50, *after which*, move the large hand *backwards* with the finger, until it stands accurately at 2500; the instrument is then ready for use, and should be suspended in the pocket by the hook attached to the pendant bow.

818. **Passometer**, as described above, in standard silver case, with crystal glass	3	0	0



243.

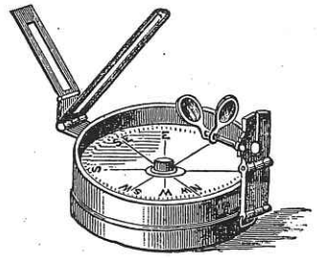


244.

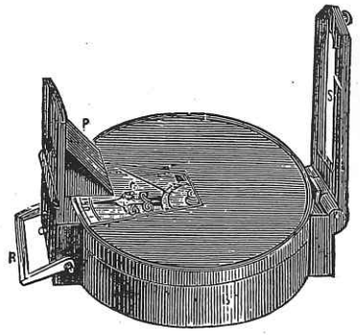
SCALE ABOUT

SEXTANTS AND QUADRANTS.

	£	s.	d.
819. **Metal Quadrant,** improved pattern, divided on ivory, with tangent screw to index, fixed adjustment, in polished mahogany box (Fig. 244)	2	10	0
820. **Metal Quadrant,** as preceding, with fine shades for coloured screen glasses	2	15	0
821. **Telescope to above** extra	0	8	6
822. **Metal Quadrant** with handle, divided on ivory with two telescopes, swing arm, microscope and six shades, fixed horizon adjustment, in superior French polished mahogany case	4	10	0
823. **Metal Quadrant,** divided on silver, with fittings as No. 822, fixed adjustment, complete	5	0	0
824. **Best Metal Quadrant,** with achromatic telescopes, long centre, seven shades and fixed adjustment	5	10	0
825. **Metal Sextant,** flat-faced limb, bronzed, divided on silver to 10 seconds, fixed adjustment, achromatic telescopes, in polished mahogany case	6	10	0
826. **Metal Sextant,** oval pattern limb, bronzed, open swing arm, reflector to the nonius saddle-piece and vertical screw adjustment	7	10	0
827. **Metal Sextant,** oval pattern limb, extra power to telescopes, open arm swing microscope, reflector to nonius and fixed adjustment and straps (Fig. 243)	9	10	0
828. **Metal Sextant,** triangular pattern limb, improved bridge to handle, fittings as No. 827, with strapped fixed adjustment	11	10	0
829. **Double Plated or Pillar Sextant**	15	0	0
830. **Artificial Horizon,** black glass in case with level	2	2	0
831. **Artificial Horizon,** brass roof, two troughs and mercury in iron bottle, complete	4	15	0



245.



246.

SCALE ABOUT ¼TH.

IMPROVED "HUTCHINSON" PRISMATIC COMPASS.*

This instrument is greatly improved, and has been adopted by the various branches of the English and Foreign Services. It is lighter and less bulky than the old form, and has no loose cover. It has only to be taken out of its case, the prism box and sight vane raised, and it is ready for use. These qualities cannot fail to recommend this improved Compass to military men and surveyors.

	£	s.	d.
832. **"Hutchinson" Improved Prismatic Compass,** bronzed, with self-acting stop, best agate cap, in superior morocco case, 3-in. (Fig. 246)	1	17	6
833. **"Hutchinson" Improved Prismatic Compass,** in best solid leather sling case	2	0	0

PRISMATIC COMPASSES.

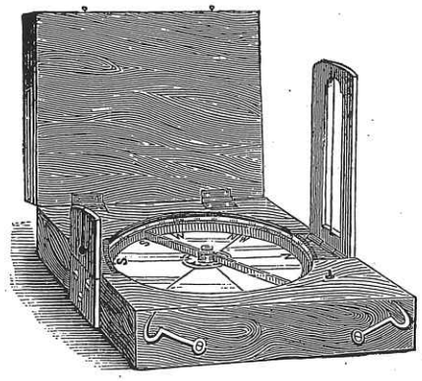
834. **Prismatic Compass,** in morocco case, 2-in. (Fig. 245)	1	5	0
835. **Prismatic Compass,** plain sights, card dial, 3-in.	2	2	0
836. **Prismatic Compass,** do. do. 3½-in.	2	5	0
837. **Prismatic Compass,** do. do. 4-in.	2	10	0
838. **Prismatic Compass,** card dial, shades, &c. 2-in.	1	12	6
839. **Prismatic Compass,** card dial, shades and mirror, 3-inch	2	15	0
840. **Prismatic Compass,** card dial, &c., 3½-in.	3	3	0
841. **Prismatic Compass,** card dial, sun shades, 4-in.	3	7	6
842. **Starlight or Moonlight Compass,** large bar needle, transparent glass dial, showing a traveller's bearings by the lighting of a cigar or match held beneath it, in hinged leather case, 1⅝-in. diameter	0	17	6

843. **Singer's Patent Compasses,** mother-o'-pearl floating dials with stop and agate cap in gilt or German silver watch shape case, one half black, to facilitate reading by night in the open air.

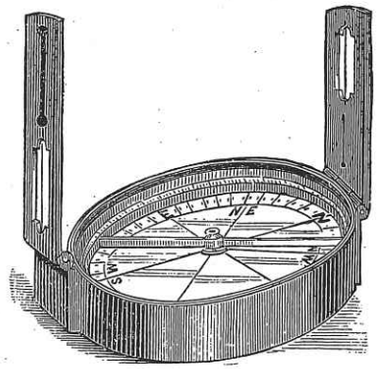
1⅜-in.	1¼-in.	1½-in.	1⅝-in.	1⅞-in.	2-in.
12/6	15/6	17/6	18/6	21/-	25/-

Engine-divided, silver or aluminium rings to either of the above sizes, extra 15/6

* All Prismatic Compasses in sling cases except 2-in.



247.
SCALE ABOUT 1-3RD.



248.
SCALE ABOUT 1-3RD.

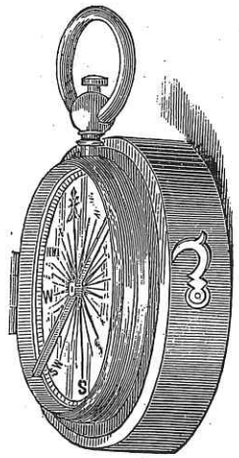
SURVEYING COMPASSES.

	£	s.	d.
844. **Brass Box Surveying Compass**, bar needle, agate cap and stop, 2-in., 12/6; 2¼-in., 15/6; 2½-in.	0	18	6
845. **Brass Box Surveying Compass**, floating card, agate cap and stop, 2-in., 12/6; 2¼-in., 15/6; 2½-in.	0	18	6
846. **Brass Box Surveying Compass**, bar needle, agate cap and stop, raised engine-divided circle, engraved bottom, in bronze case, 2¼-in., 21/-; 2½-in, 25/-; 3-in., 27/6; 3½-in.	1	10	0
847. **Brass Box Surveying Compass**, bar needle, agate cap and stop, raised engine-divided circle, bottom divided every ten degrees (Fig. 248), 2¼-in., 27/6; 2½-in., 32/-; 3-in., 42/-; 3½-in.	2	10	0
848. **Surveying Compass**, bar needle or floating card, with stop and agate cap, in mahogany box (Fig. 247), 2-in., 12/6; 2½-in., 15/6; 3-in.	0	18	6

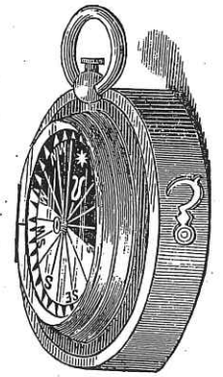
POCKET COMPASSES.

849. **Pocket Compass**, pull-off cover, 1-in.	0	1	0
850. **Pocket Compass**, do. 1½-in.	0	1	3
851. **Pocket Compass**, do. and float, 1½-in.	0	1	6
852. **Pocket Compass**, do. do. 1¾-in.	0	2	0
853. **Pocket Compass**, do. blued needle, enamelled card dial, 1⅞-inch, silvered lining	0	3	0
854. **Pocket Compass**, do. do. 1¾-in.	0	4	0
855. **Pocket Compass**, do. do. 2¼-in.	0	5	0
856. **Pocket Compass**, do. do. 2½-in.	0	6	0

The above are supplied with Floating Cards, or SINGER'S Patent Card Dial, without extra charge. Stops are charged 1/- each extra.



249.
SCALE FULL SIZE.



250.
SCALE FULL SIZE.

251.
SCALE FULL SIZE.

WATCH COMPASSES.

		£	s.	d.
857.*Pocket Compasses, enamel dials, strongly gilt or German silver cases, bar needles or floating cards, agate centres and stop, in leather case (Figs. 249 and 250) 1⅛-in. 12/6; 1¼-in. 13/6; 1½-in. 15/6; 1⅝-in. 17/6; 1⅞-in. 18/6; 2-in. 21/-				
858. **Watch Compass** in silver hunting case (Fig. 251)	1¼-in.	2	0	0
859. **Watch Compass**, do. do.	1½-in.	2	5	0
860. **Watch Compass** in German silver hunting case	1¼-in.	1	5	0
861. **Watch Compass**, do. do. do.	1½-in.	1	7	6
862. **Watch Compass**, do. do. do.	1¾-in.	1	10	0
863. **Sun-dial Compass**, in oblong boxwood case, with equation table		0	7	6
864. **Sun-dial Compass**, do. polished do.		0	8	6
865. **Sun-dial Compass**, 1¾-in. diameter in common round wood case. (Plain), 1/- each; (plain) cocos, 4/- each; (agate cap), 5/-; (sq. best), 7/6; plain (metal), 5/6; agate cap (metal), 6/6; (German silver), agate cap and stop, each.		0	8	6
866.†**Universal Sun-Dial and Compass** with portable arc divided and engraved for observations in the northern and southern hemispheres, packed in morocco or mahogany case, 2½-in.		2	2	0
867. **Universal Sun-Dial and Compass** with portable arc, &c., as preceding, 3½-in.		3	3	0
868. **Universal Sun-Dial and Compass** with portable arc, &c., as preceding, 4½-in.		4	4	0

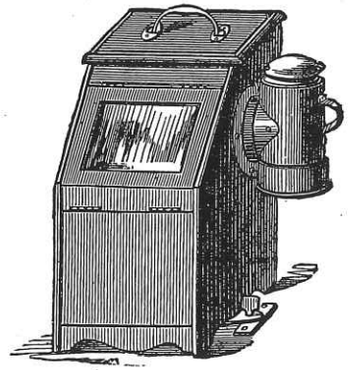
* Singer's Patent Pearl Dials same prices.

† Full directions for use, with Tables, furnished with each Instrument.

In damp tropical climates a silvered dial becomes tarnished, or a card one obliterated. The *enamel* dials, however, completely resist the action of moisture, and are, therefore, highly recommended.



253.
FULL SIZE SHUT.



252.
SCALE ABOUT 1-12TH.



254.
FULL SIZE OPEN.



255.
FULL SIZE SHUT.



256.
FULL SIZE OPEN.

BINNACLE AND CHARM COMPASSES.

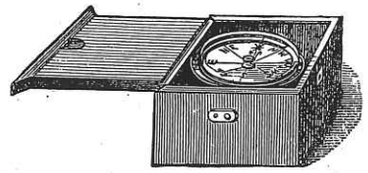
These Compasses are constructed expressly for Yachts, Boats, &c., and are of the best quality. They are in mahogany cases, with gymbal rings and copper bowls. The cards are balanced on jewelled centres so as to give the least amount of friction. The Compasses being complete in boxes they can be taken in and out of the binnacle at pleasure.

The Binnacles are of polished mahogany with glass fronts, brass lamps, and are furnished with plates and bolts to facilitate attachment to and removal from the deck.

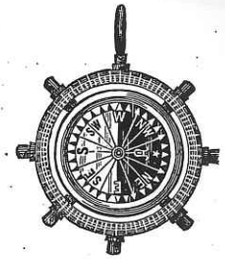
	£	s.	d.
869. **Binnacle and Compass** with 2½-in. card dial and brass lamp, complete (Fig. 252)	2	2	0
870. **Binnacle and Compass** with 3-in. card dial and brass lamp, complete	2	10	0
871. **Binnacle and Compass** with 3½-in. card dial and brass lamp, complete	3	0	0
872. **Charm Compass,** 10-carat bright gold revolving ball (Figs. 253 and 254)	1	12	6
873. **Charm Compass,** 15-carat bright gold SINGER'S dial, jewelled centre, extra stout case (Figs. 255 and 256)	2	10	0
874. **Brass horizontal Sun-Dial,** divided to 5 minutes, with eight points of the compass engraved, 6-in.	1	1	0
875. **Brass horizontal Sun-Dial,** divided to 5 minutes, with eight points of the compass engraved, 8-in.	1	15	0
876. **Brass horizontal Sun-Dial,** divided to 5 minutes, with eight points of the compass engraved, 10-in.	2	10	0
877. **Brass horizontal Sun-Dial,** divided to 5 minutes, with eight points of the compass engraved, 12-in.	3	3	0
878. **Brass horizontal Sun-Dial,** divided to 5 minutes, with eight points of the compass engraved, 12-in., with Equation Tables	4	15	0



257.
FULL SIZE.



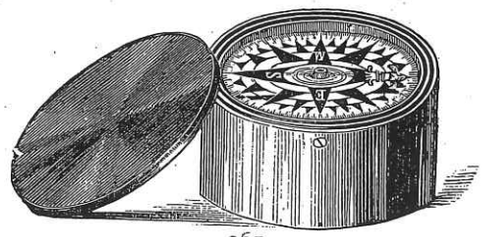
258.
SCALE ABOUT 1-6TH.



259.
FULL SIZE.



260.
FULL SIZE.



261.
SCALE ABOUT 1-4TH.



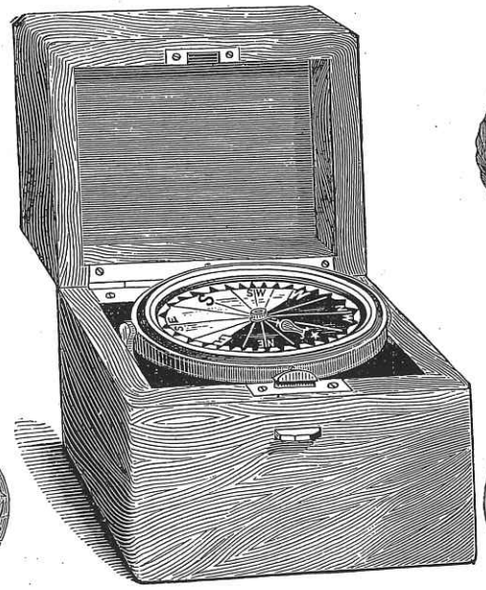
262.
FULL SIZE.

BINNACLES,
BOATING AND CHARM COMPASSES.

	£	s.	d.
879. **Boat Steering Compass** in square oak box, 5-in.	0	9	6
880. **Boat Steering Compass,** square box on gimbals, agate cap, SINGER'S card dial, 4-in., 10/6 (Fig. 258); 5-in., 12/6; 6-in.	0	15	6
881. **Boating Compass,** agate cap, SINGER'S pearl dial, 2½-in., 18/6; 3-in., 21/-; 3½-in.	1	5	0
882. **Boating Compass,** agate cap, SINGER'S or ordinary card dial, 2½-in., 15/6; 3-in., 17/6; 3½-in. (Fig. 261)	1	1	0
883. **Box Compass,** pull-off lid, agate cap, bar needle, with stop of best make, 1⅜-in., 6/6; 1¾-in., 7/6; 2¼-in., 8/6; 2½-in.	0	10	6
884. **Box Compass,** agate cap, float card, SINGER'S, or ordinary card dial, with stop, 1⅜-in., 6/-; 1¾-in., 7/-; 2¼-in., 8/-; 2½-in.	0	9	0
885. **Stop Compass,** SINGER'S patent pearl dial, agate cap, 1⅜-in., 10/6; 1¾-in.	0	12	6
886. **Charm Compass,** stout 15-carat gold, SINGER'S patent pearl dial (Fig. 257) 35/-; ditto wheel pattern (Fig. 259)	2	5	0
887. **Charm Compass** (Fig. 260), 15-carat, 10/6 (Fig. 262)	1	12	6
888. **Ship's Binnacle,** improved lantern and lamp, polished mahogany case, deck plates, &c., 10-in., £7; 11-in., £7 15s.; 12-in., £8 10s.; 13-in.	9	10	0
889. **Ship's Binnacle,** japanned and gilt, dolphin design, &c., 11-in., £10; 12-in., £10 10s.; 13-in., £12; 14-in.	13	0	0
890. **Ship's Binnacle,** bright brass body, spiral pillar, lamps, &c., 12-in., £12 10s.; 13-in., £14; 14-in.	15	10	0
891. **Ship's Binnacle,** plain design but highly finished in bright brass, 10-in., £12; 11-in., £13; 12-in.	15	10	0



264.
FULL SIZE.



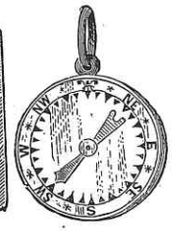
263.
SCALE ABOUT 1-4TH.



265.
FULL SIZE.



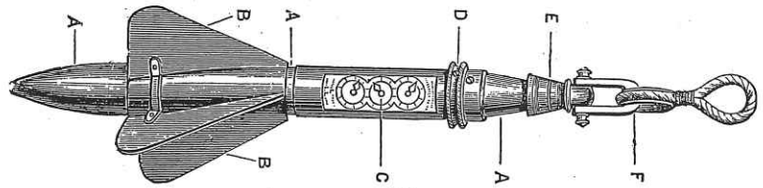
266.
FULL SIZE.



267.
FULL SIZE.

YACHTING AND CHARM COMPASSES.

	£	s.	d.
892. **Steering Compass** in wood box, 8-in., 8/6; 9-in., 9/6; 10-in., 10/6; 11-in., 11/6; 12-in.	0	12	6
893. **Steering Compass**, superior make, agate centres, brass bowls in gimbals, enclosed in oak box, 7-in., 12/6; 8-in., 13/6; 9-in., 15/6; 10-in., 17/6; 11-in., 18/6; 12-in.	1	1	0
894. **Hanging Cabin Compass**, in superior brass mounting, small size, 4½-in., 25/-; large size, 5¼-in.	1	7	6
895. **Marine Gimbal Brass Compass**, in polished mahogany velvet-lined case, SINGER'S pearl dial (Fig. 263), 4-in.	1	7	6
896. **Marine Gimbal Brass Compass**, in lined case, brasswork gilt and burnished, SINGER'S pearl dial, 4-in.	1	15	6
897. **Marine Gimbal Brass Compass**, same as preceding, in walnut case, 4-in.	2	15	0
898. **Charm Compass**, locket pattern with cover, engraved case, SINGER'S dial, 10-carat, 27/6; 15-carat (Fig. 266)	1	15	0
899. **Charm Compass**, stone back, cable pattern edge, SINGER'S dial, 15-carat (Fig. 265)	1	10	0
900. **Charm Compass**, enamel dial, bar needle, 15-carat (Fig. 264)	1	15	0
901. **Charm Lens Compass**, with two plano-convex Brazilian pebble lenses, between which the needle works on a pivot, compass points painted on inside rim, silver case, 15/6; 15-carat gold case (Fig. 267)	1	1	0



268.
SCALE ABOUT 1-6TH.

MASSEY'S FRICTIONLESS PROPELLER CONICAL END LOG.

902. AA Log tube and cones in one length, containing register.
BB Vanes or wings, soldered and secured by brass stays obliquely on the Log tube; the water acting against these, causes the tube and register to revolve.
C Dial plate, with its indices, which shows the distance run.
D Milled edge to cover, by turning which, the indices are exposed or protected.
E Convex cup or protector, of gun-metal, attached to the shaft on which the Log revolves, and which prevents anything fouling between the shaft and the cone's point.
F Thimble to which the towing-rope is fastened. £3 15 0

MASSEY'S FRICTIONLESS SOUNDER.

903. This improved machine can be used with a common Deep Sea Lead. The Sounding Frame, constructed with a ring guard, so as to protect the rotator. The upper portion of this frame is made with a hollow chamber, in which are placed the registering wheels, thus securing them from all action of, and pressure from the water, and also from being fouled or injured in any manner.

The Rotator is furnished with a ring guard for protection.

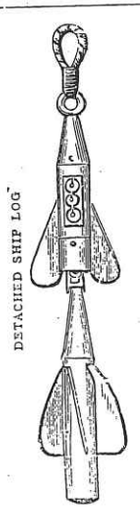
The Index Cover with pointer contains the dial, divided into fathoms, and registers 120 fathoms. The dial-plate, being enamelled, will not turn black, or corrode.

The Thimbles are for attaching the sinking weight, and also the inboard rope for recovering the machine. Sounder, no lead, £3 3 0

MASSEY'S HAND-LEAD AND DEEP SEA SOUNDING MACHINE,

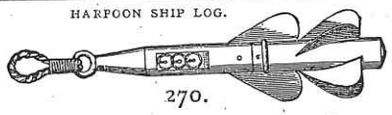
904. Consists of the shield, the beak or locking, the friction or locking spring, the rotator, the register of 15 fathoms, which is connected with a wheel on the reverse of the plate containing a register of 225 fathoms.

In using the machine, raise the shield with its beak, turn the rotator till the scale stands at 15, then pull down the shield till the beak is held by the friction spring, by which means the rotator is locked and prevented from turning. It is now ready for use. When the machine arrives at the surface of the water, the shield is forced up; the rotator, being free, commences to revolve, and communicates the depth to which the machine descends to the register. When the machine is hauled in, the shield falls, locks, and prevents further movement of the rotator, thus securing accuracy in the indications. Complete, £3 10 0



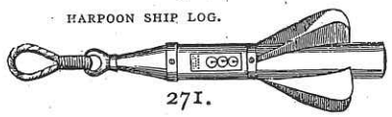
269.
SCALE ABOUT 1-8TH

HARPOON SHIP LOG.



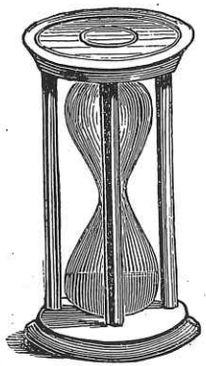
270.

HARPOON SHIP LOG.

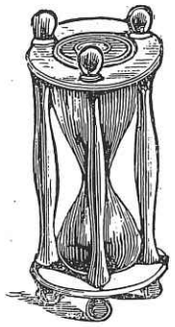


271.

SCALE ABOUT 1-8TH.

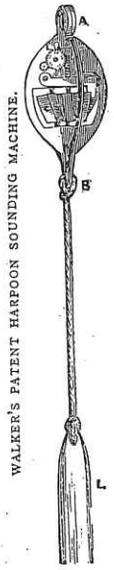


273.



274.

SCALE ABOUT 1-3RD.



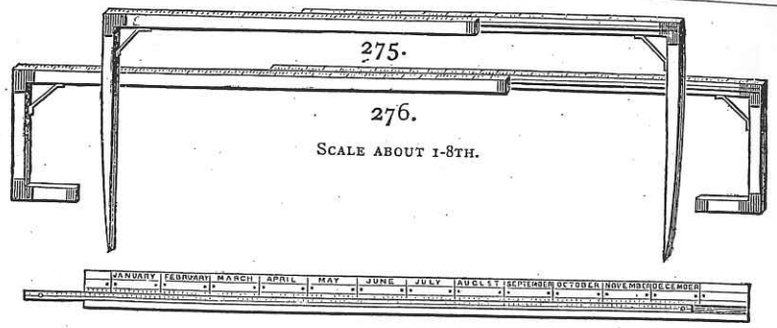
272.
SCALE ABOUT 1-8TH.

SHIP LOGS AND SOUNDING MACHINES.

		£	s.	d.
905.	Sounding Machines (Fig. 272)	2	12	6
906.	Harpoon Ship Log (Fig. 270)	3	10	0
907.	Harpoon Ship Log (Fig. 271)	2	10	0
908.	Detached Ship Log (Fig. 269)	2	10	0
909.	Massey's Ship Log			

TIME GLASSES.

910.	Log Glasses, wood frames, 14 seconds	0	1	3
911.	Log Glasses, do. 28 seconds	0	1	3
912.	Log Glasses, brass frames 14 or 28 seconds	0	3	6
913.	One-minute Glass, in wood frame	0	1	0
914.	Three-minute Glass do.	0	1	3
915.	Five-minute Glass do.	0	1	6
916.	Quarter Hour Glass do.	0	1	9
917.	Half Hour Glass do. (Fig. 273)	0	1	9
918.	One Hour Glass do.	0	2	0
919.	Two Hour Glass do.	0	3	6
920.	Quarter Hour Glasses, in rosewood or cocos wood frame	0	8	6
921.	Half Hour Glasses do. do. (Fig. 274)	0	10	6
922.	One Hour Glasses do. do.	0	12	6
923.	Quarter Hour Glasses, in brass frames	0	10	6
924.	Half Hour Glasses do.	0	13	6
925.	One Hour Glasses do.	0	15	6
926.	Tea Brokers' Sample Glasses, plain wood frame	0	1	6
927.	Auctioneers' One-minute Glasses, in pocket case	0	10	6
928.	Time Glasses, in ivory or fancy frames, in various designs, to order			



275.

276.

SCALE ABOUT 1-8TH.

277.

GAUGING RULES AND RODS.

These Rules of seasoned boxwood, and Rods of equally well-seasoned lance or satinwood, enable Wine, Spirit and Oil Merchants to ascertain the quantity of spirit, wine, beer, oil, &c., in any Cask.

		£	s.	d.
929.	Cross Calliper of either of the above woods (Fig. 275)	1	0	0
930.	Long Calliper do. do. (Fig. 276)	1	0	0

RENT RULES.

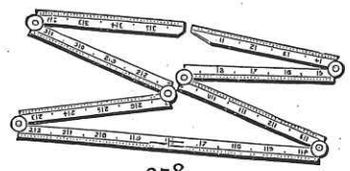
931.	Rent Rule, 18-inch, boxwood (for ascertaining the number of months, weeks and days from one date to another) for one year (Fig. 277)	0	6	0
932.	Rent Rule, 12-inch, double do. do. for two years	0	11	6

VACUITY RULE.

933.	Vacuity Rule, 24-inch, for ascertaining the number of gallons out or in a cask	0	9	0

BAR CASK RULES,

For ascertaining, by dipping, the contents of Bar Casks.



278.

934.	Bar Cask Rule, 3-feet, six-folding (Fig. 278)	0	6	6
935.	Bar Cask Rule, 3-feet, eight-folding	0	8	6
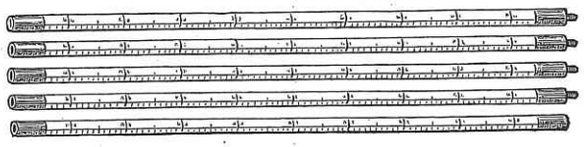
BOTTLE RULES,

For ascertaining, by dipping, the contents of Bouge or Cylinder Stone Bottles or Jars.



279.

936.	Bottle Rule, 2-feet, four-folding (Fig. 279)	0	3	6
937.	Bottle Rule, 2-feet, six-folding	0	6	6



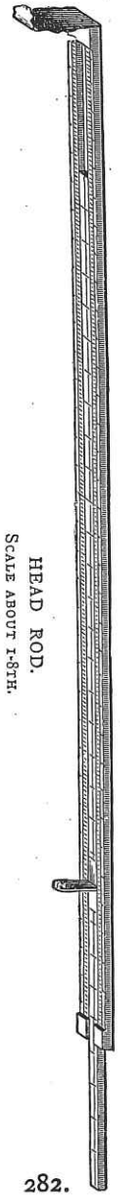
280.
Scale about 1-5th.

HEAD ROD, BUNG RODS, &c.

	£	s.	d.
938. **Head Rod**, boxwood (Fig. 282) .	1	0	0
939. **Bung Rod**, 4-feet, with brass slider	0	10	0
940. **Bung Rod**, ,, in one length .	0	8	0
941. **Bung Rod**, ,, Customs' pattern	0	6	0
942. **Bung Rod**, 4-feet, with socket joint at 3 feet (Fig. 281) . . .	0	7	6
943. **Bung Rod**, 5-feet, in one length .	0	11	0
944. **Bung Rod**, ,, Customs' pattern	0	7	0
945. **Bung Rod**, 5-feet, in one length, extra stout, with solid tip, for oil gauging	0	9	0
946. **Bung Rod**, 5-feet, socket joint at 3 feet	0	8	6
947. **Complete Set of Gauging Instruments**, as used by Her Majesty's Customs—including Cross Calliper, Long Calliper, Head Rod, 4-feet Bung Rod with brass slider, and book of instructions. The instruments supplied in lance, satin, or boxwood	3	10	0



BUNG ROD, WITH BRASS SLIDER.
Scale about 1-8th.



HEAD ROD.
Scale about 1-8th.

SPILE RODS,

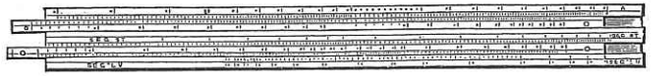
281. For ascertaining the dip of a Cask through the spile hole

282.

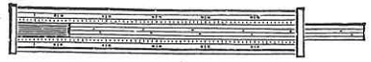
	£	s.	d.
948. **Spile Rod**, 3-feet, screw-jointed	0	6	0
949. **Spile Rod**, 4-feet, do.	0	8	0
950. **Spile Rod**, 5-feet, do. (Fig. 280). . . .	0	10	0
951. **Spile Rod**, 6-feet, do.	0	12	0
952. **Straight Spile Rod**	0	2	6



283.
Scale about 1-4th.



284.
Scale about 1-4th.



285.
Scale about 1-4th.

COMPARATIVE RULES.

For determining the number of gallons of water necessary to reduce Spirits; also the relative value of Spirits.

	£	s.	d.
953. **Comparative Rule**, 6-inch, boxwood (Fig. 283) .	0	3	0
954. **Comparative Rule**, 9-inch, do. with directions	0	5	0
955. **Comparative Rule**, 12-inch, do. do. .	0	5	6
956. **Comparative Rule**, 18-inch, do. do. .	0	7	6
957. **Comparative Rule**, 24-inch, do. do. .	0	10	0
958. **Comparative Rule**, 30-inch, do. do. .	0	12	0
959. **Comparative Rule**, 36-inch, do. do. .	0	15	6
960. **Comparative Rule**, 6-inch, ivory do. .	0	8	6
961. **Comparative Rule**, 9-inch, do. do. .	0	10	6
962. **Comparative Rule**, 12-inch, do. do. .	0	16	0

ULLAGE RULES.

For ascertaining, in conjunction with a Dip Rule, the Ullage of any sized Cask.

963. **Plain Ullage Rule**, 12-inch, with instructions (Fig. 284)	0	5	6
964. **Plain Ullage Rule**, 18-inch, do. . .	0	7	0
965. **Plain Ullage Rule**, 24-inch, do. . .	0	9	0
966. **Plain Ullage Rule**, 36-inch, do. . .	0	15	0

PROOF, OR TEMPERATURE RULES.

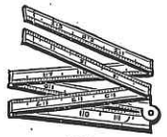
For using with Sikes' Hydrometer in the cellar, instead of the Book of Tables.

967. **Proof, or Temperature Rule**, 6-inch, boxwood (Fig. 285)	0	3	0
968. **Proof, or Temperature Rule**, 9-inch, do. .	0	5	0
969. **Proof, or Temperature Rule**, 18-inch, do. .	0	7	6
970. **Proof, or Temperature Rule**, 24-inch, do. .	0	10	0

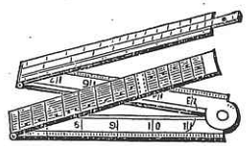
DOUBLE DIAGONAL RODS,

Imperial and Old Measure, with Table of Outs of Casks.

971. **Gauging Rod**, 5-feet, double diagonal, with Table of Outs	0	6	6
972. **Gauging Rod**, 4-feet, do. do. .	0	5	6
973. **Gauging Rod**, 5-feet, single diagonal do. .	0	6	0
974. **Gauging Rod**, 4-feet, do. do. .	0	5	0



286.



287.

Scale about 1-3rd.



288.

MEASURING RULES.

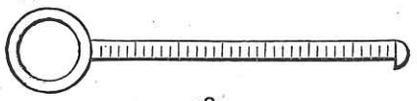
	£	s.	d.
975. **Foot Rule**, four-fold, boxwood, divided into inches, and eighths or tenths (Fig. 287) 1/- to	0	2	6
976. **Foot Rule**, four-fold, ivory do. do. (Fig. 288) 3/6 to	0	8	6
977. **Two Foot Rule**, four-fold, boxwood do. 1/6 to	0	3	6
978. **Two Foot Rule** do. ivory do. 7/6 to	1	1	0
979. **Two Foot Rule**, two-fold, boxwood do. 1/6 to	0	3	6
980. **Two Foot Rule** do. ivory do. 12/6 to	1	1	0
981. **Two Foot Rule**, six-fold, boxwood do. (Fig. 286) 4/6 to	0	7	6
982. **Two Foot Rule**, do. ivory do. do. 15/6 to	1	10	0

STRAIGHT GAUGING RODS,

Same work on, as Folding Rules.

983. **Gauging Rod**, 4-feet, lancewood (Fig. 291) .	0	5	0
984. **Gauging Rod**, 5-feet, do. . . .	0	6	0
985. **Gauging Rod**, 6-feet, do. . . .	0	7	6
986. **Gauging Rod**, 4-feet, brass or steel . .	1	5	0
987. **Gauging Rod**, 5-feet, do. . . .	1	10	0
988. **Gauging Rod**, 6-feet, do. . . .	1	15	0

BRASS STAVE GAUGE.

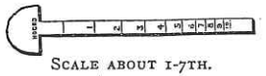


289.

Scale about 1-7th.

989. **Brass Stave Gauge** (Fig. 289) . . .	0	1	6

BOXWOOD ULLAGE STICK.



Scale about 1-7th.

290.

990. **Boxwood Ullage Stick** (Fig. 290) . .	0	1	9

MEASURING TAPE.

991. **Measuring Tape**, 72-inch, divided into inches and tenths, with weight	0	3	6

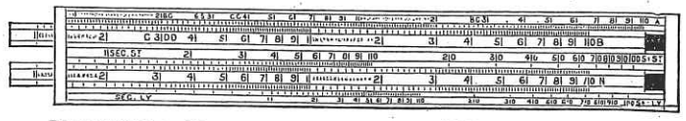


STRAIGHT GAUGING ROD.

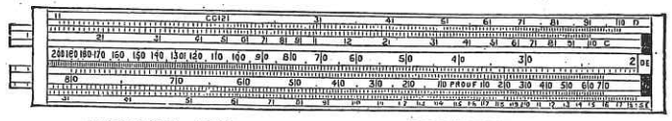
291.

LATHS.

992. **Lancewood Lath**, 24-inch	0	2	0
993. **Lancewood Lath**, 48-inch	0	3	0
994. **Lancewood Lath**, 72-inch	0	4	0

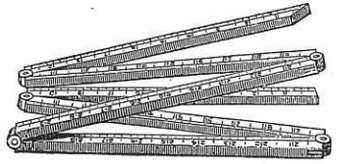


Scale about 2-3rd. 292. ULLAGING SLIDE.



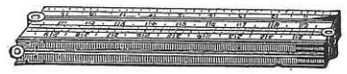
GAUGING AND 293. REDUCING SLIDE.

Scale about 1-3rd.



294.

Scale about 1-6th.



295.

Scale about 1-6th.

TWO-SIDED GAUGING, ULLAGING, REDUCING AND VALUING RULES.

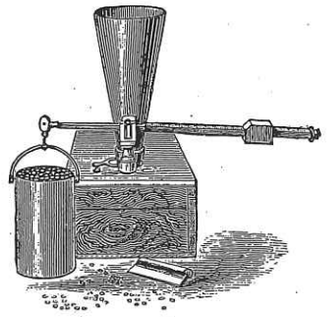
By these Rules, in conjunction with a dip Rule, the contents of any sized cask can be ascertained, and the value of spirits determined.

	£	s.	d.
995. **Gauging, Ullaging and Reducing Rule**, 6-in., two-slided, boxwood (Figs. 292 and 293)	0	6	0
996. **Gauging, Ullaging and Reducing Rule**, 9-in., do.	0	7	6
997. **Gauging, Ullaging and Reducing Rule**, 12-in., do.	0	9	0
998. **Gauging, Ullaging and Reducing Rule**, 18-in., do.	0	12	0
999. **Gauging, Ullaging and Reducing Rule**, 24-in., do.	0	14	0
1000. **Gauging, Ullaging and Reducing Rule**, 6-in., two-slided, ivory	0	13	6
1001. **Gauging, Ullaging and Reducing Rule**, 9-in., do.	1	3	6
1002. **Gauging, Ullaging and Reducing Rule**, 12-in, do.	1	10	0

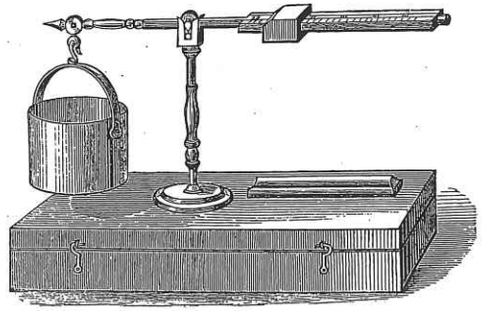
DIPPING RULES, &c.,

With line of inches and tenths, diagonal line. Dips for Spirit Casks, and every sized Beer Cask.

	£	s.	d.
1003. **Wine and Spirit Rule**, 6-feet, 12-folding . .	0	17	6
1004. **Wine and Spirit Rule**, 6-feet, 8-folding . .	0	10	6
1005. **Wine and Spirit Rule**, 6-feet, 6-folding (Fig. 294)	0	8	0
1006. **Wine and Spirit Rule**, 5-feet, 8-folding . .	0	10	0
1007. **Wine and Spirit Rule**, 5-feet, 6-folding . .	0	7	0
1008. **Wine and Spirit Rule**, 4-feet, 8-folding . .	0	10	0
1009. **Wine and Spirit Rule**, 4-feet, 6-folding . .	0	7	0
1010. **Wine and Spirit Rule**, 4-feet, 4-folding (Fig. 295)	0	5	6
1011. **Wine and Spirit Rule**, 3-feet, 6-folding . .	0	7	0
1012. **Wine and Spirit Rule**, 3-feet, 4-folding . .	0	5	0
1013. **Wine and Spirit Rule**, 4-feet, 6-folding . .	0	7	0
1014. **Wine and Spirit Rule**, 4-feet, 4-folding . .	0	5	6



296.



297.

SCALE ABOUT 1-6TH.

CHONDROMETER.

Chondrometer or Corn Balance, for showing the weight per bushel of wheat, barley, oats, &c. Carefully adjusted by the imperial standard, used throughout the United Kingdom since 1826.

To use this Instrument: 1st—Fill the measure or bucket carefully, and with the roll strike off the top; 2nd—Hook the bucket or measure on the end of the scale beam, then move the brass weight till it just balances the bucket and its contents, and the degree marked on the brass slide on which it stands will be the weight of an eight-gallon bushel of the grain tested.

On account of the small and delicate proportions of this Instrument, care must be taken in weighing the bearded and rougher kinds of grain, and as they are more liable to be torn up in striking off the top than smooth small grains, they must be charged somewhat heavier, or they will lose too great a proportion in so small a quantity, and thereby appear too light. If the Flat Strike be used instead of the Roll, the Grain will appear to be from 1 to 2lbs. per bushel lighter.

Seventeen Specimens of the weight of marketable Grain per bushel.

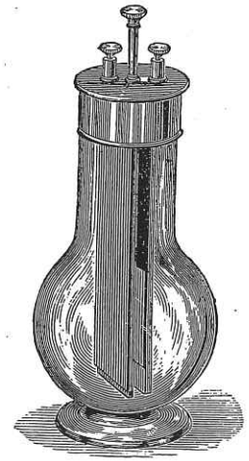
Wheat is from 55 to 63lbs. per bushel, mean weight 60.

	lbs.	lbs.	mean wt.
Rye	50	to 56	53
Barley	46	„ 54	50
Red Clover	60	„ 66	63
White ditto	66	„ 70	68
Dutch ditto	65	„ 71	68
Hemp	38	„ 42	40
Linseed	44	„ 54	49
Turnip	48	„ 50	49
Oats	35	„ 42	38½

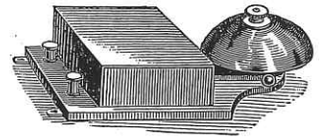
	lbs.	lbs	mean wt.
Meadow Grass	10	to 18	14
Rye ditto	12	„ 28	20
Cinque Foil	22	„ 28	25
Peas	62	„ 67	64
Small Beans	60	„ 66	63
Canary	54	„ 56	55
Rape	47	„ 50	48½
Buck Wheat	45	„ 52	48½

	£	s.	d.
1015. **Chondrometer,** with funnel, 1-pint (Fig. 296)	5	5	0
1016. **Chrondometer,** with funnel, ½-pint	4	0	0
1017. **Chondrometer,** without funnel, 1-pint, £3 3s.; ditto ½-pint, £2 15s.; ditto ¼-pint, £2 5s.; ditto ⅛-pint (Fig 297)	2	0	0

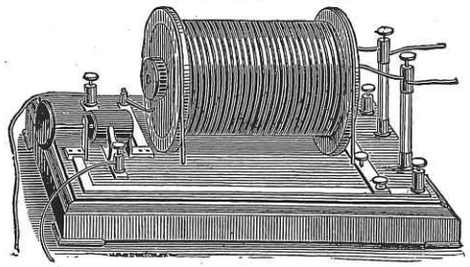
Can be made for Foreign Measures, or with several Scales.



298.
SCALE ABOUT 1-8TH.



299.
SCALE ABOUT 1-8TH.



300.
SCALE ABOUT 1-8TH.

INDUCTION COILS.

	£	s.	d.
1018. **Ruhmkorff Coil,** small size, ⅛-in. spark	0	18	6
1019. **Ruhmkorff Coil,** ditto, with commutator	1	1	0
1020. **Ruhmkorff Coil,** ditto, ⅜-in. ditto, ditto	1	7	6
1021. **Ruhmkorff Coil,** ¼-in. ditto, ditto	1	10	0
1022. **Ruhmkorff Coil,** ½-in. ditto, ditto	2	15	0
1023. **Ruhmkorff Coil,** 1-in. ditto, ditto	5	5	0
1024. **Ruhmkorff Coil** 1-in. ditto,with upright commutator	6	6	0
1025. **Ruhmkorff Coil,** 2-in. ditto, ditto	10	10	0
1026. **Ruhmkorff Coil,** 3½-in. ditto, ditto	15	15	0
1027. **Ruhmkorff Coil,** 4-in. ditto, ditto	17	17	0
1028. **Ruhmkorff Coil,** 6-in. ditto, ditto	22	0	0
1029. **Whirling Apparatus,** for GASSIOT'S Star, £3 10s. to	5	5	0

Special quotations for larger sizes.

1030. **Bottle Battery,** small size	0	5	6
1031. **Bottle Battery,** ditto, ½ pint	0	10	6
1032. **Bottle Battery,** ditto, 1 pint	0	12	6
1033. **Bottle Battery,** ditto, 1 quart	0	15	6
1034. **Bottle Battery,** ditto, 2 quarts	1	8	6
1035. **Bottle Battery,** ditto, 2 quarts, 2 elements	1	15	0
1036. **Electric Bells,** No. 1, 2-in. bells	0	10	0
1037. **Electric Bells,** No. 2, 2¾-in. ditto	0	10	6
1038. **Electric Bells,** No. 3, 3-in. ditto	0	12	6
1039. **Electric Bells,** No. 4, 3½-in. ditto	0	15	0
1040. **Electric Bells,** No. 5, 4-in. ditto	0	17	6

Electrical apparatus of every description for experiments.

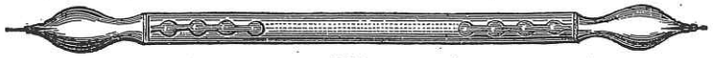
1041. **Insulated Wire,** for connections, per 100 yards, from 1 1 0

Relative lengths and weights of cotton covered copper wire, as used for electro-galvanic and telegraphic purposes.

No.	6	9	12	14	18	23	32	34
Feet.	8	18	39	48	130	360	1,300	2,000 to the lb. weight.



301.



302.



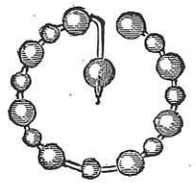
303.



304.

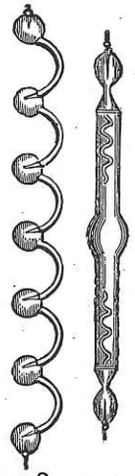


305.

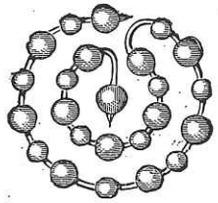


306.

SCALE ABOUT 1-5TH.



308. 309.



307.

SCALE ABOUT 1-5TH.

	£	s.	d.
1042. Vacuum Tube (Fig. 301)	1	5	0
1043. Vacuum Tube (Fig. 302)	1	10	0
1044. Vacuum Tube (Fig. 303)	0	17	6
1045. Vacuum Tube (Fig. 304)	1	10	0
1046. Vacuum Tube (Fig. 308)	1	6	0
1047. Vacuum Tube (Fig. 306)	1	10	0
1048. Vacuum Tube (Fig. 307)	2	0	0
1049. Vacuum Tube (Fig. 309)	1	10	0
1050. Vacuum Tube (Fig. 304)	1	7	6
1051. Vacuum Tube (Fig. 305)	0	18	6

GASSIOT'S VACUUM TUBES.

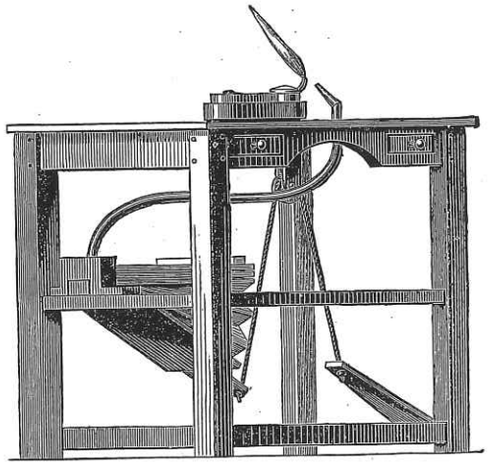
GASSIOT'S Vacuum Tubes, for showing the stratification of the electric discharge in vacuo, in illustration of the interesting and valuable researches of J. P. GASSIOT, Esq., F.R.S., as described by him at the meetings of the British Association for the Advancement of Science in 1858 and 1859, and also in various papers contributed by him to the Transactions of the Royal Society.

The following Large Vacuum Tubes for Scientific illustration are made under J. J. H.'s personal superintendence and the contents are guaranteed. From No. 1052 to No. 1066 are about 30 inches long by 1¾-in. diameter, and are exhausted with any gas required.

	£	s.	d.
1052. **Vacuum Tube,** with two aluminium rings, two platinum plates and two platinum terminals	1	17	6
1053. **Vacuum Tube,** with three aluminium rings, two platinum plates and two aluminium terminals	2	5	0

	£	s.	d.
1054. **Vacuum Tube,** with two aluminium spheres, one aluminium ring, four platinum plates and two aluminium terminals	2	5	0
1055. **Vacuum Tube,** with one palladium spiral terminal and one palladium straight terminal and hydrogen gas	2	15	0
1056. **Vacuum Tube,** with large aluminium spiral covered with pieces of glass tubing, one aluminium ring, one platinum plate and two aluminium terminals	2	15	0
1057. **Vacuum Tube,** with three glass stopcocks for measuring quantities of gas admitted, aluminium or magnesium dish at one end and magnesium cone at the other	2	15	0
1058. **Vacuum Tube,** for showing double discharge, four platinum terminals, two covered and two exposed	1	12	6
1059. **Vacuum Tube,** *double* tube with three glass stopcocks, centre cock for admitting gas, aluminium ring and wire one end, aluminium ring covered with pieces of glass and magnesium ball at the other	2	17	6
1060. **Vacuum Tube,** with two glass stopcocks, magnesium dish at one end and aluminium spiral at the other	2	2	0
1061. **Vacuum Tube,** with aluminium terminal and rolling uranium bead inside	1	12	6
1062. **Vacuum Tube,** large globe at each end and aluminium sphere inserted in each	1	10	0
1063. **Vacuum Tube,** with five platinum plates and two aluminium terminals	1	15	0
1064. **Vacuum Tube,** with one aluminium ring and two aluminium wires passing through uranium globes inside	1	17	6
1065. **Vacuum Tube,** with magnesium dish and aluminium sphere, two aluminium spirals, one aluminium ring and two platinum plates	2	5	0
1066. **Vacuum Tube,** with six graduated sizes of aluminium rings, one large aluminium spiral and two aluminium terminals	2	15	0
1067. **Vacuum Tube,** 30 inches long, 1¼-in. diameter, with Torricellian vacuum and platinum terminals	1	10	0
1068. **Vacuum Tube,** 20 inches long, 2 inches diameter, with diaphragm in centre, aluminium wire and aluminium spiral	1	17	6
1069. **Vacuum Tube,** 15 inches long, 1½-in. diameter, with diaphragm in centre, aluminium globe and magnesium cone	1	12	6
1070. **Vacuum Cylinder,** 8 inches long, 6 inches diameter, for showing large stratifications, with magnesium globe and aluminium dish	2	15	0
1071. **Vacuum Cylinder,** 8 inches long, 6 inches diameter, with aluminium dish and cone	2	15	0
1072. **Vacuum Cylinder,** 8 inches long, 6 inches diameter, with magnesium dish and aluminium ring	2	15	0
1073. **Vacuum Tube,** smaller size, a double cone with series of aluminium rings	1	17	6

Any tube or design exhausted with any gas, furnished with terminals of any metal, made to drawing or order.



310.

Scale about 1-18th.

GASSIOT'S VACUUM TUBES.

		£	s.	d.
1074.	**Set of Six Tubes,** in paper box	0	8	6
1075.	**Set of Six Tubes,** in paper box	0	9	0
1076.	**Set of Five Tubes,** superior quality . 18/6 and	1	1	0
1077.	**Gassiot Vacuum Tube,** rose design . 30/- and.	2	15	0
1078.	**Gassiot Vacuum Tube,** spiral flat do. . 7/6 to	2	15	0
1079.	**Gassiot Vacuum Tube,** marguerite do. . 7/6 to	0	15	6
1080.	**Set of 10-inch Tubes,** containing Nitrogen, Hydrogen, Carbonic Acid, &c.	1	10	0
1081.	**Spirals,** globular 8/6 to	2	15	0
1082.	**Spirals,** conical 15/6 to	1	5	0
1083.	**Gassiot's Cascade** small 7/- to	0	17	6
1084.	**Gassiot's Cascade,** large	1	17	6
1085.	**Induction Tubes,** with concentrating balls, two gases 7/6 to	0	15	6
1086.	**U-shaped Tubes** 13/6 to	1	5	0
1087.	**U-shaped Tubes,** without liquids	0	10	0
1088.	**Diadems with Cross** 18/6 to	2	15	0
1089.	**Crosses with Ball** 7/6 to	0	15	6
1090.	**Uranium Vases and long balls** . . 7/6 to	1	5	0
1091.	**Holz Tubes,** showing direction of current 15/6 to	0	18	6
1092.	**Flowers,** small model, 9/- to 15/6; large ditto 27/6 to	2	2	0
1093.	**Tubes,** with six liquids	2	5	0
1094.	**Tubes,** with four liquids	1	10	0
1095.	**Tubes,** with Death's Head . . . 13/6 to	0	17	6
1096.	**Inscriptions** on black ground, per letter	0	1	9
1097.	**Inscriptions** enclosed in tube, per letter	0	2	3

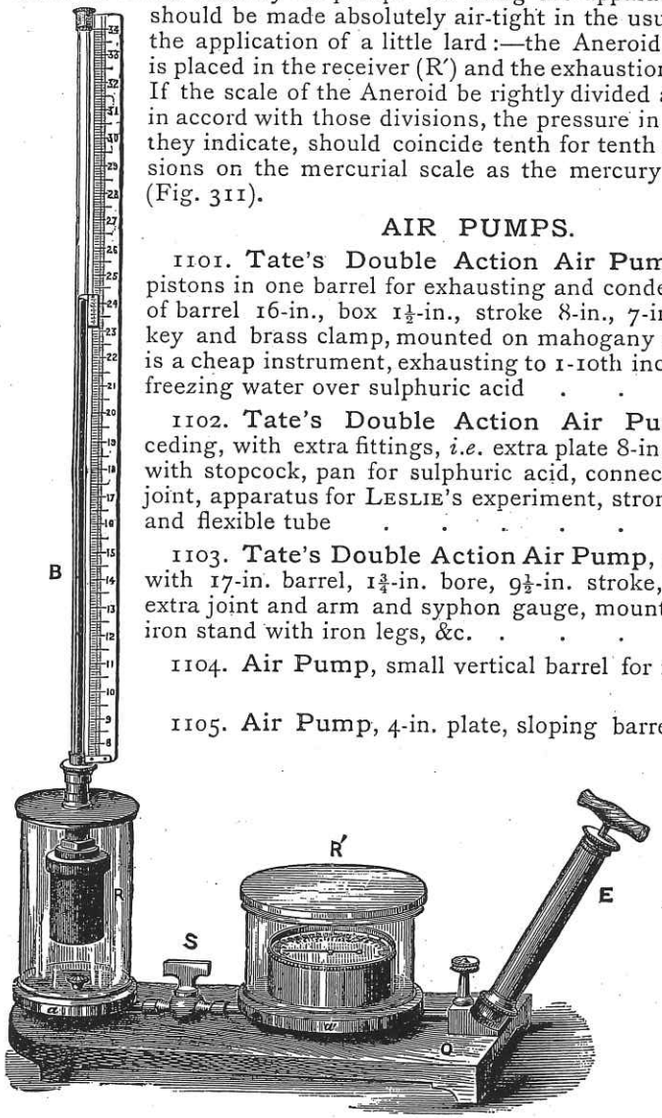
GLASS BLOWERS' BELLOWS.

1098. **Glass Blowers' Bellows,** full size, double action, improved jets, jet holder, scissors, square table, lamp, and brass mountings complete (Fig. 310) 3 3 0

1099. **Glass Blowers' Bellows** for laboratory use, of compact circular form, enclosed in round pedestal, square table, jets, scissors, lamp, &c., complete . . . 5 10 0

APPARATUS FOR TESTING ANEROIDS.

1100. This consists of a Standard Mercurial Barometer (B) with engine-divided metal scale, each inch of which is compensated for capacity; the cistern being enclosed in the receiver (R), which communicates by the tube and stopcock (S) with the larger receiver (R′) containing the Aneroid, while undergoing the process of testing. It will thus be seen that the two receivers virtually form one chamber, the compartments of which are simultaneously exhausted of air by the powerful exhausting syringe (E). The base-board (O) and the circular plates (A A′) are the same as in an ordinary air-pump. In using the apparatus, all joints should be made absolutely air-tight in the usual manner by the application of a little lard:—the Aneroid, to be tested, is placed in the receiver (R′) and the exhaustion commenced. If the scale of the Aneroid be rightly divided and the works in accord with those divisions, the pressure in inches which they indicate, should coincide tenth for tenth with the divisions on the mercurial scale as the mercury falls or rises (Fig. 311). £10 10 0



Scale about 1-6th.

AIR PUMPS.

1101. **Tate's Double Action Air Pump,** with two pistons in one barrel for exhausting and condensing, length of barrel 16-in., box 1½-in., stroke 8-in., 7-in. plate, with key and brass clamp, mounted on mahogany stand. This is a cheap instrument, exhausting to 1-10th inch and readily freezing water over sulphuric acid . . . £4 4 0

1102. **Tate's Double Action Air Pump,** as preceding, with extra fittings, *i.e.* extra plate 8-in. in diameter, with stopcock, pan for sulphuric acid, connecting tube and joint, apparatus for Leslie's experiment, strong iron clamp and flexible tube £6 6 0

1103. **Tate's Double Action Air Pump,** as preceding, with 17-in. barrel, 1¾-in. bore, 9½-in. stroke, 10-in. plate, extra joint and arm and syphon gauge, mounted on strong iron stand with iron legs, &c. £8 0 0

1104. **Air Pump,** small vertical barrel for micro objects £0 15 6

1105. **Air Pump,** 4-in. plate, sloping barrel, iron stand £1 1 0

AIR PUMPS.

	£	s.	d.
1106. **Air Pump**, 5-in. plate, sloping barrel, mahogany stand	1	12	6
1107. **Air Pump**, 6-in. plate, sloping barrel, glass receiver, stopcock, mahogany stand	2	10	0
1108. **Double Barrel Air Pump**, 8-in. plate and clamp	8	8	0
1109. **Double Barrel Air Pump**, 9-in. plate, guage plate, mercurial syphon guage, clamp, &c.	12	0	0
1110. **Double Barrel Air Pump**, on stand with independent stage, 3-ft. high, 10-in. plate, barometer guage, cistern and key	25	0	0
1111. **Bell-shaped Receivers** 5/6 to	0	18	6
1112. **Condensing Syringe**, 8-in., 10/6; 12-in.	1	1	0
1113. **Exhausting Syringe**, 8-in., 9/6; 12-in.	1	0	0
1114. **Exhausting and Condensing Syringe**, 8-in. 15/6; 12-in.	1	5	0
1115. **Dr. Sprengel's Mercurial Air Pump** . £3 3s. to	7	7	0
1116. **Prof. McLeod's Mercurial Air Pump**, £3 10s. to	8	8	0
1117. **Professor Crookes's Mercurial Air Pump**	22	0	0
1118. **Dr. Geissler's Mercurial Air Pump** £4 10s. to	8	8	0
1119. **Philosophical or Water Hammer** . 3/6 to	0	5	6
1120. **Cryophorous (Dr. Wollaston's)** . . 3/6 to	0	5	6

ATMOSPHERIC ELECTRICITY.

1121. **Saussure's Electrometer** (modified.)—The basis of the arrangement is a flint glass narrow mouthed bottle, with a divided scale to indicate the degree of divergence of the gold leaves or straws. To protect the lower part from rain it is covered by a metallic shield about five inches in diameter. (Fig. 312) £1 10 0

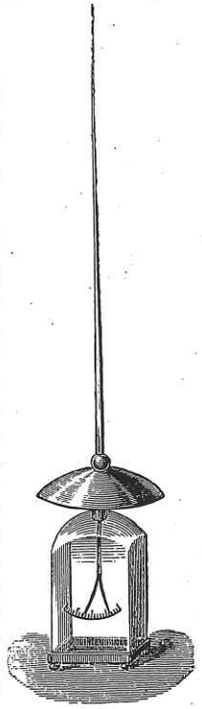
1122. **Book of Gold Leaf**, to replace torn or broken leaves in the Electrometer . . £0 1 6

1123. **Singer's Electroscope** with condensing plates and joint. This instrument resembles the preceding, but has the addition of a pair of condensing plates £1 15 0

1124. **Bohnenberger's Electroscope** indicates the presence and quality of *feeble* electric currents. A ZAMBONI'S pile forms part of the arrangement, and the distance of the terminal plates from the gold leaves is adjustable £7 7 0

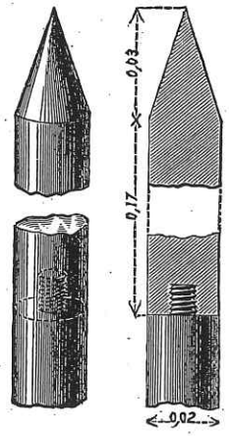
1125. **Peltier's Electrometer** indicates the presence and amount of electricity by the deflection of a magnetic needle. It is highly sensitive . £5 5 0

1126. **Singer's Atmospheric Electroscope.**—This is an ordinary Gold Leaf Electrometer, to the circular brass disc of which a two feet brass rod is attached, having a clip at its upper extremity to receive a lighted paper or cigar fusee. Electricity is attracted by the smoke and flame, and conveyed by the rod to the gold leaves under the glass shade. The *kind* of electricity prevalent at the time of the experiment is determined by the application of a stick of *excited* sealing-wax, or glass, supplied with the instrument £1 7 6



312.
SCALE ABOUT 1-7TH.

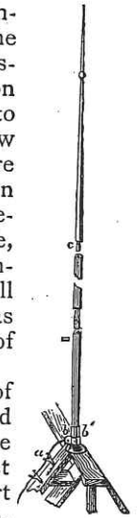
LIGHTNING CONDUCTORS.



313.
SCALE ABOUT ½.

It is impossible to overrate the importance of these safeguards against the destructive effects of excessive discharges of atmospheric electricity on buildings and ships. In reference to the latter, the late SIR WILLIAM SNOW HARRIS states that, whereas, before their application to the Royal Navy, an annual expenditure of £10,000 was necessary, to say nothing of loss of life, "since the system of Lightning Conductors has been fully carried out in all H.M. ships, damage by lightning has positively vanished from the records of the Navy."

Lightning Conductors are supplied of solid copper, pointed at the top, and when fixed, are allowed to extend some feet above the highest point of the mast or building. Copper wire rope is used for the greater part of the length, the *solid* copper sometimes tipped with platinum, being used for the upper portion. The convenience attached to the use of wire rope is, that it adapts itself to the inequalities of the building to which it may be applied, and is quite safe if used of sufficient diameter to prevent fusion, and if the end is carried some feet below the surface or preferably into a well of water.



314.
SCALE 1-10TH.

Estimates furnished for fixing Lightning Conductors.

	£	s.	d.
1127. **Copper Wire Rope**, per 100 ft., ⅜-in., 75/-; ½-in.	5	0	0
1128. **Plain tin-tipped Terminals**, with staples, &c., per foot, ⅜-in., 1/10; ½-in.	0	2	0
1129. **Forked tin-tipped Terminals**, per foot, ⅜-in., 2/-; ½-in.	0	2	4
1130. **Platinum Points**, according to weight, per oz., variable			
1131. **Lightning Conductors**, as used in front of telegraph instruments, with any number of platinum wires to order; with four wires	0	8	6

EUDIOMETERS.

1132. **Mitscherlich's Eudiometer** to 1-100ths of a cubic inch	1	0	0
1133. **Ure's Eudiometer**, about 50 c.c. to show 1-10th c.c.	0	7	0
1134. **Volta's Eudiometer**	0	7	6
1135. **Bunsen's 30-in. Eudiometer**, divided to millimetres	0	10	0
1136. **Bunsen's Transfer Eudiometer**, 12-in. long, ditto	0	5	6
1137. **Bunsen's Syphon Barometer** in millimetres, with stand and plummet	1	5	0
1138. **Bunsen's Syphon Barometer**, as preceding, with Gay Lussac's pipette and stand complete, best make	2	0	0

ALKALIMETERS.

	£	s.	d.
1139. Schuster's Alkalimeter	0	1	6
1140. Normandy's Alkalimeter	0	10	0
1141. Gay Lussac's Alkalimeter	0	5	6
1142. Binks' Alkalimeter	0	5	6
1143. Binks' Alkalimeter, with foot	0	6	6
1144. Clark's Tube Retort and Receiver	0	1	0
1145. Fresenius' and Wills' Carbonic Acid Apparatus	0	3	0
1146. Parnell's Carbonic Acid Apparatus	0	2	6
1147. Liebig's Potash Apparatus	0	2	6
1148. Mitscherlich's Potash Apparatus	0	2	6
1149. Nitrogen Tube	0	1	6
1150. Chloride of Calcuim Tubes, straight 1 bulb	0	1	0
1151. Chloride of Calcuim Tubes, V shape 2 bulbs	0	1	6
1152. Drying Tube	0	1	6
1153. Glass Syphons, all sizes and lengths . from	0	1	6
1154. Mohr's Burette	0	1	6
1155. Pipettes, with mark on neck to any given capacity from 1/- to	0	2	6
1156. Measuring Flasks, with mark on neck to cubic centimetres, litre, pints, &c. 1/6 to	0	5	0
1157. Stoppered Test Mixers, 1 litre divided to 100 parts	0	9	6
1158. Graduated Glass Measures, conical or cylindrical, 1-dr., 1/-; 1-oz., 1/-; 2-oz., 1/-; 5-oz., 1/3; 10-oz., 1/6; 20-oz.	0	2	6

SPECTACLES, FOLDERS AND EYE-GLASSES.

1159. Iron Spectacles, with convex glasses, . . from	0	1	0
1160. Steel Spectacles, medium quality	0	2	0
1161. Steel Spectacles, better quality	0	2	6
1162. Steel Spectacles, with pebbles, from	0	5	6
1163. Steel Spectacles, with tinted glasses	0	3	6
1164. Steel Spectacles, hook sides, with grooved glasses for riding, from	0	5	0
1165. Best Dust Spectacles, with tinted glasses, gauze sides, and velvet bound, in case	0	12	6
1166. Dust Spectacles, French	0	4	6
1167. Dust Spectacles, French, velvet bound	0	5	0
1168. Goggles, with elastic sides and nose	0	2	0
1169. Goggles, with elastic sides and nose, velvet bound	0	2	6
1170. Steel Frames, with tinted bulged glasses	0	4	6
1171. Steel Frames, with tinted bulged glasses, best	0	5	6
1172. Common Horse-shoe Spectacles with tinted glasses	0	3	6
1173. Common Hose-shoe Spectacles, best quality, London made, neutral, or blue glasses	0	8	6
1174. Two-spring Stout Steel Folders, glazed with concave or convex glasses	0	4	6
1175. Two-spring Fine Steel Folders, with grooved glasses	0	7	6
1176. Two-spring Fine Steel Folders, shell plaquet glasses	0	9	6

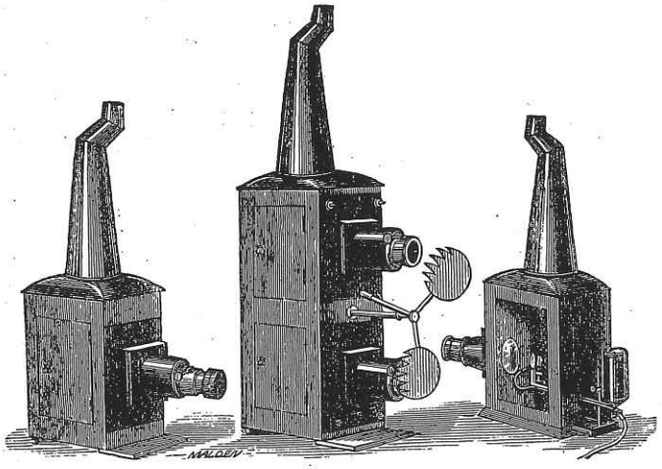
SPECTACLES, FOLDERS AND EYE-GLASSES.

	£	s.	d.
1177. Two-spring Shell Folders, concave and convex	0	4	6
1178. Two-spring Shell Folders, concave and convex, superior	0	7	6
1179. Two-spring Ebonite Folders, convex	0	2	6
1180. Two-spring Ebonite Folders, concave	0	3	0
1181. Steel Folders, with Chinese nose . from 3/- to	0	7	6
1182. Steel Folders, with Chinese nose . from 4/- to	0	9	6
1183. Round Shell Folders, with steel crank nose	0	12	6
The above glazed with convex pebbles, 5/6 extra per pair.			
1184. Shell Pivot Folders, without stop	0	3	0
1185. Shell Pivot Folders, with stop	0	3	6
1186. Shell Pivot Folders, superior, with stop	0	4	6
1187. Shell Pivot Folders, with spring stop	0	5	0
1188. Ebonite Pivot Folders, 1/6, 2/-, 2/6 and	0	3	0
1189. Single Eye Glasses, drilled and milled	0	1	0
1190. Single Eye Glasses, with shell mounts, 1/- and	0	2	0
1191. Single Eye Glasses, with ebonite mounts	0	1	0
1192. Single Eye Glasses, with steel mounts	0	1	6
1193. Single Eye Glasses, milled edge and white metal handle	0	1	0
1194. Ladies' Hand Frames, shell and gilt	0	10	0
1195. Ladies' Hand Frames, shell and silver gilt	0	18	0
1196. Ladies' Hand Frames, metal gilt	0	10	6
1197. Ladies' Hand Frames, silver gilt	1	0	0
1198. Ladies' Hand Frames, gold plated	1	15	0
1199. Ladies' Hand Frames, gold plated, best	2	2	0
1200. Best Spectacle Glasses	0	1	0
1201. Best Spectacle Glasses, neutral tint	0	2	0
1202. Convex Pebbles, oval	0	2	6
1203. Convex Pebbles, round	0	3	0
1204. Concave Pebbles, oval	0	3	0
1205. Concave Pebbles, round	0	3	6

READING GLASSES.

1206. Reading Glasses, German silver mounts, black handles from	0	2	6
1207. Reading Glasses, German silver mounts, ivory handles from	0	4	6
1208. Reading Glasses, gilt mounts . . . from	0	5	6
1209. Reading Glasses, horn mounts . . . from	0	5	6
1210. Reading Glasses, vulcanite mounts . . from	0	2	0
1211. Reading Glasses, all shell mounts . . from	0	6	0
1212. Reading Glasses, square horn frames, with cylindrical glasses from	0	9	6
1213. Pocket Ebonite Magnifying Glasses, shutting from	0	1	0
1214. Pocket Ebonite Magnifying Glasses, shutting from	0	2	0
1215. Pocket Ebonite Magnifying Glasses, double lenses from	0	2	6
1216. Pocket Ebonite Magnifying Glasses, Triple lenses from	0	3	6

CODDINGTON Lenses of every description mounted in bone, ivory and German silver



315. 316. 317.

SCALE ABOUT 1-15TH.

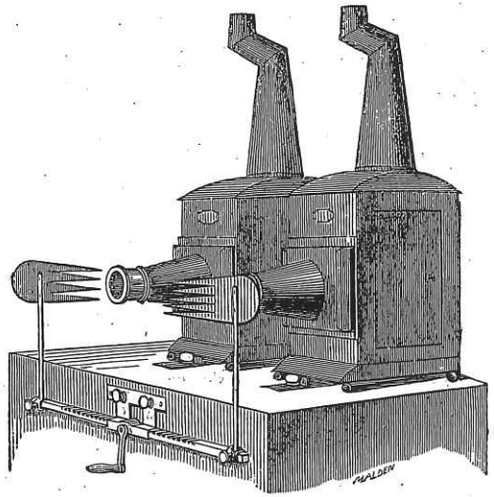
MAGIC LANTERNS.

These are of stout japanned tin, with single-lens condensers and object glasses, from No. 1217 to No. 1223. The Phantasmagoria Lanterns, from No. 1224 to No. 1229, have double condensers and fronts.

	£	s.	d.
1217. **Magic Lantern** with brass jacket and sliding front, rack and pinion adjustment to lamp	0	4	6
1218. **Magic Lantern,** as preceding	0	6	6
1219. **Magic Lantern** ditto 2-in. condenser	0	10	6
1220. **Magic Lantern** ditto 2½-in. condenser	0	14	6
1221. **Magic Lantern** ditto 3-in. condenser	1	0	0
1222. **Magic Lantern** ditto 3-in. condenser, brass front, argand lamp in black box	1	11	6
1223. **Magic Lantern,** as preceding, 3½-in. condenser	2	2	0

PHANTASMAGORIA LANTERNS.

1224. **Phantasmagoria Lantern,** 3-in. compound condensers, brass sliding front, and fountain argand oil lamp	3	0	0
1225. **Phantasmagoria Lantern,** 3½-in. compound condensers, sliding brass front, and fountain argand oil lamp	3	13	6
1226. **Phantasmagoria Lantern,** as preceding, with *achromatic* object glass	4	4	0
1227. **Phantasmagoria Lantern,** as preceding, polished mahogany body tin lined, *double achromatic* object glass, rack and pinion adjustment, fountain argand oil lamp	5	5	0
1228. **Phantasmagoria Lantern,** as No. 122, with oxycalcium spirit lamp, retort purifier, wedge gas bag, pressure board, tubing and 1 dozen lime cylinders	8	8	0
1229. **Phantasmagoria Lantern,** 4-in. condensers, superior brass front, polished body, tin lined, rack adjustment, oxycalcium spirit lamp, retort, purifier, wedge gas bag, pressure board, tubing and 1 dozen lime cylinders	9	9	0

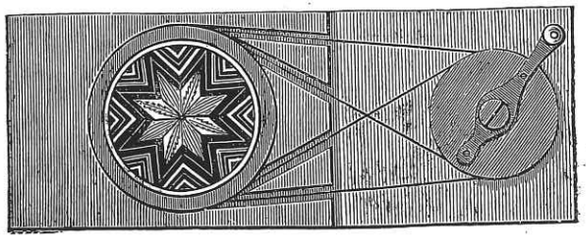


318.

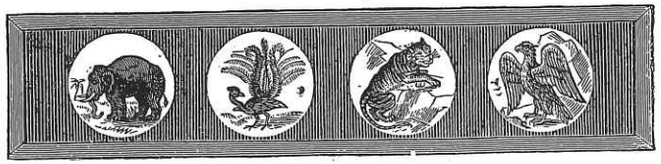
SCALE ABOUT 1-15TH.

DISSOLVING VIEW APPARATUS.

	£	s.	d.
1230. **Dissolving View Lanterns,** japanned tin, sliding fronts, 3-in. compound condensers, rack dissolver	7	10	0
1231. **Dissolving View Lanterns,** as preceding, with 3½-in. condensers (Fig. 318)	9	0	0
1232. **Dissolving View Lanterns,** 3½-in. compound condensers, achromatic fronts and rack dissolver	10	10	0
1233. **Dissolving View Lanterns,** with polished mahogany bodies lined with tin, rackwork fronts, achromatic object glasses, 3½-in. compound condensers, rackwork dissolver	12	0	0
1234. **Dissolving View Lanterns and Apparatus,** including oxycalcium spirit lamps, retort purifier, wedge gas bag, pressure board, tubing, 1 dozen lime cylinders, 3½-in. compound condensers	13	13	0
1235. **Dissolving View Lanterns,** as preceding, achromatic object glasses, with rack and pinion adjustment, mahogany bodies lined with tin	17	5	0
1236. **Bi-Unial Lanterns,** polished mahogany body lined with tin, rack and pinion adjustment, achromatic lenses, six-way dissolving tap, retort, purifier, two oxyhydrogen lamps, 3½-in. compound condensers, 2 india-rubber gas bags, large size pressure board, tubing and lime cylinders, suitable for Lecturers and Public Entertainments (Fig. 316)	26	0	0
1237. **Oxycalcium Spirit Lamp**	0	15	0
1238. **Oxycalcium Gas Lamp**	1	1	0
1239. **Oxyhydrogen Gas Jet**	1	5	0
1240. **Microscope for the Lantern,** 1 power	1	11	6
1241. **Microscope for the Lantern,** 2 powers	1	12	6
1242. **Achromatic Power,** with rack adjustment	2	17	6



319.



320.
SCALE ABOUT 1-4TH.

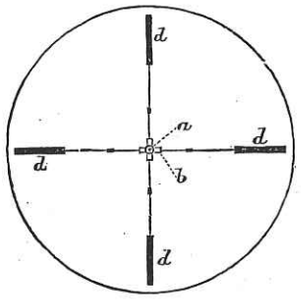
ACCESSORIES FOR LANTERNS.

		£	s.	d.
1243.	**India-Rubber Gas Bags**, from £1 10s. to . .	9	9	0
1244.	**India-Rubber Tubing**, per foot, 4d. and . .	0	0	5
1245.	**Changing Comic Slides**, slipping for lanterns, large per doz.	1	1	0
1246.	**Changing Comic Slides**, slipping for lanterns, small per doz.	0	15	0
1247.	**Changing Comic Slides**, large lever, for lanterns, per doz.	2	12	6
1248.	**Changing Comic Slides**, small lever, for lanterns, per doz.	2	2	0
1249.	**Conundrums for Lanterns** . . . per doz.	0	15	0
1250.	***Nursery Tales**, in sets from 6 to 12 slides, per slide	0	4	0
1251.	**Rackwork Fountains, Mills, &c.**, 3-in. . each	0	12	6
1252.	**Chromatropes**, 50 patterns, 2½-in., 10/6; 3-in., each	0	12	6
1253.	**Sets of Views** with effects for Dissolving for Lanterns, Nos. 1224 to 1236, best quality, 3-in. from 12/6 to	1	17	6
1254.	**Hymns**, mounted in mahogany frames . . each	0	1	6
1255.	**Scripture History**, coloured each	0	3	6
1256.	**Statuary**, from the Art Galleries of Europe . each	0	4	6

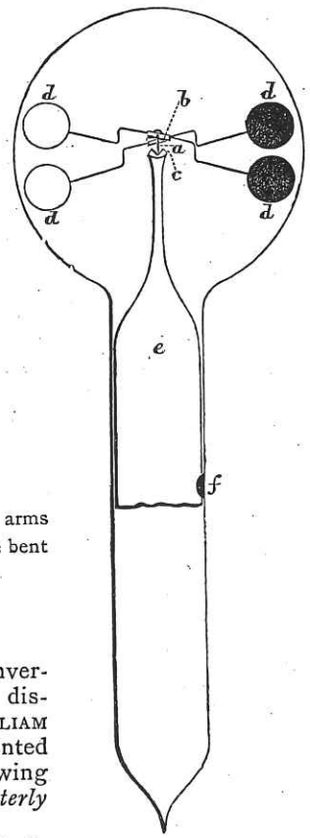
* All the Popular Tales supplied.

MODEL STEAM ENGINES.

	Stationary.						
1257.	Condensing Beam Engine .	from £5	5/-	to	50	0	0
1258.	High Pressure Beam Engine .	,, £10	10/-	to	80	0	0
1259.	Oscillating Cylinder Horizontal .	,, £2	2/-	to	20	0	0
1260.	High Pressure Horizontal .	,, £3	3/-	to	25	0	0
1261.	High Pressure Vertical . .	,, £3	3/-	to	25	0	0
	Locomotive.						
1262.	Oscillating Cylinder . . .	from £3	3/-	to	15	15	0
1263.	High Pressure Cylinder . .	,, £6	6/-	to	25	0	0
	Marine.						
1264.	Oscillating Paddle . . .	from £2	2/-	to	20	0	0
1265.	High Pressure Paddle . .	,, £10	10/-	to	50	0	0
1266.	High Pressure Screw . .	,, £10	10/-	to	50	0	0



321.
SCALE ABOUT.



322.
SCALE ABOUT 2-3RDS.

CROOKES' RADIOMETER.

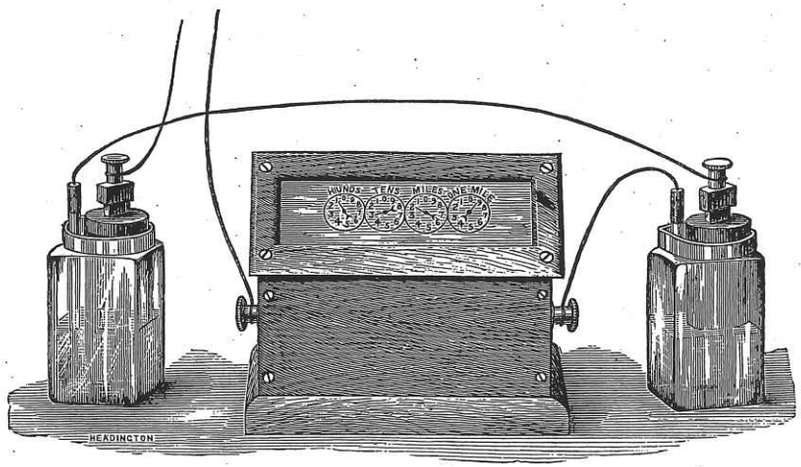
a A very fine needle point.
b Two pieces of straw.
c Jewel cup.
dddd Four pith discs blackened on one side. The arms between the straw in the centre and the discs are bent metal or glass fibres.
e Glass support holding cup.
f Cement to keep the support *e* in its place.

An Instrument for demonstrating the conversion of light into mechanical motion, a discovery due to the patient research of WILLIAM CROOKES, Esq., F.R.S., who has appointed J. J. HICKS Sole Maker, and gives the following description of the apparatus in the *Quarterly Journal of Science*, for July, 1875.

"The Instrument which I have called a Radiometer, shown in section and plan at Figs. 321 and 322 consists of four arms, of some light material, suspended on a hard steel point, resting in a jewel cap, so that the arms are able to revolve horizontally upon the centre pivot, in the same manner as the arms of Dr. ROBINSON'S Anemometer. To the extremity of each arm is fixed a thin disc of pith, white on one side and lamp-blacked on the other, the black surfaces of all the discs facing the same way. The whole is enclosed in a thin glass globe which is then exhausted to the highest attainable point and hermetically sealed.

The arms of this Instrument rotate with more or less velocity under the action of radiation, the rapidity of revolution being directly proportional to the intensity of the light falling on the discs. Placed in the sunlight or exposed to the light of burning magnesium, the rapidity is so great that the separate discs are lost in a circle of light."

		£	s.	d.
1267.	**Crookes' Radiometer,** with black and white discs as Fig. 322, on mahogany foot	1	17	6
1268.	**Crookes' Radiometer,** with rectangular plate and silk fibre, highly sensitive	1	10	0
1269.	**Crookes' Photometer,** on the principle of the Radiometer to order			



323.

SCALE ABOUT 1-6TH.

HICKS' ELECTRIC ANEMOMETER.

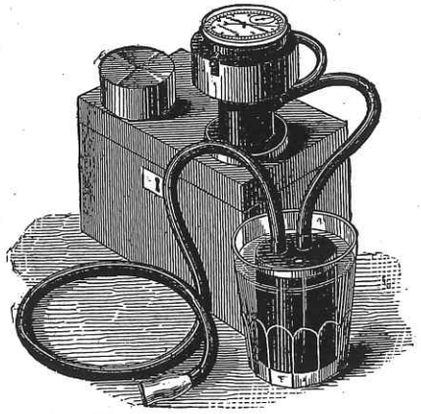
Fig. 323 shows the registering portion of the apparatus, together with batteries and arrangement of wires to connect with the set of ROBINSON'S cups, similar to Fig. 186, which is fixed on the roof of the building or other elevated situation, and furnished with a toothed-wheel and pin to make and break contact at given distances, as shown on the recording plate, Fig. 323. The registration is effected by a train of wheels, indicating from a portion of a mile to 1000 (and upward if desired) as shown on dials, and receives its motion by means of a lever and claw attached to the armature of an electro magnet, working in a rachet-wheel, the electro magnet being worked by a contrivance in the upper part of the apparatus, this part of the instrument is enclosed in a polished mahogany case, with terminals for connecting wires. It will thus be seen that this apparatus affords exceptional facilities for placing the registering arrangement in the library, dining room or other convenient place of observation.

		£	s.	d.
1270. **Hicks' Electric Anemometer**		8	10	0
1271. **Batteries**	per cell	0	3	6
1272. **Insulated Copper Wire** . . .	per yard	0	0	6

HICKS' PATENT FLEXIBLE MERCURIAL BAROMETER.

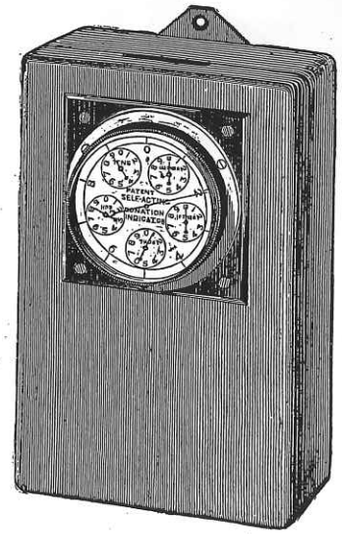
This light and elegant instrument is constructed to meet the requirements of Tourists and Surveyors, where portability, accuracy and strength are desiderata. It cannot be put out of order except by actual breakage, and its weight does not exceed one pound. It consists of a flat bulb of flexible glass filled with mercury, exhausted of all air and hermetically sealed at both ends. The inches are divided on the glass tube itself, which is mounted on a metal scale with small attached Thermometer and sliding scale to compensate for temperature, and the whole is enclosed in a morocco or solid leather case.

1273. **Hicks' Patent Flexible Barometer** . . . 6 15 0



324.

SCALE ABOUT 1-4TH.



325.

SCALE ABOUT 1-6TH.

SPIROMETER, COIN INDICATOR.

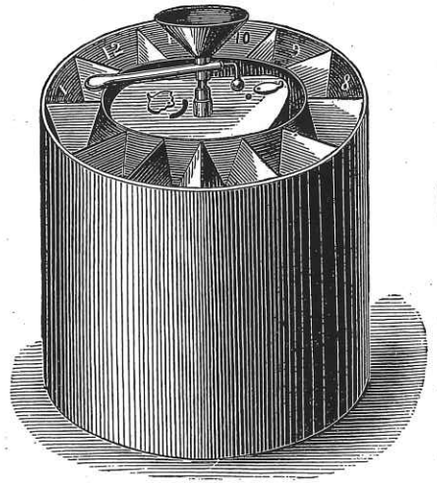
1274. **Portable Medical Spirometer** (Patent). This instrument, from its small size, will be found a very useful addition to the consulting room of the physician and to the physiological laboratory. The measurement of the vital capacity is obtained by measuring the velocity of the expired current during the time of expiration, and the instrument is arranged so as to reduce the velocity of the current to cubic measure £4 10 0

1275. **Self-acting Donation Indicator** (Patent). J. J. HICKS, Sole Agent. The instrument, as shown in the above engraving, is fixed on to the Donation Box, which is of polished oak or mahogany. The dial is silvered, and fitted into a handsomely finished brass case and covered with a glass. The hands of the Indicator all move forwards, from left to right, and count to one million donations. The long centre hand moves one division for every coin, and reads up to ten. The small dials read tens, hundreds, thousands, 10 thousands and 100 thousands, and each coin passing into the box immediately registers itself. The Indicator is a perfect check against tampering with the box. £3 3 0

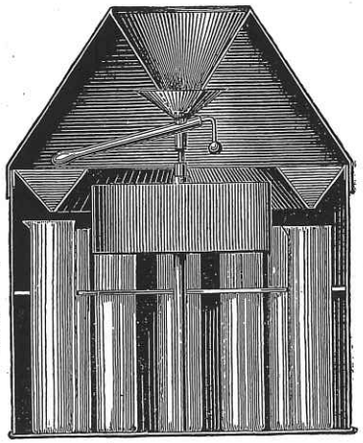
It is believed this instrument will be found of great value to Charitable Institutions, as many persons, from curiosity, would be induced to place a coin in the box to see the hands of the Indicator move, and would feel a satisfaction in seeing their contribution registered.

TELESCOPES.

Day and Night, Marine, Deer-Stalking, Tourists, Astronomical and Educational, in every variety



326.
SCALE ABOUT 1-7TH.



327.
SCALE ABOUT 1-7TH.

STUTTER'S SELF-RECORDING RAIN-GAUGE.
(HICKS' PATENT).

The importance of *Self-recording* instruments in yielding *continuous* records of Meteorological changes is now fully recognized, their cost has, however, hitherto prevented their general use. The Rain-gauge here described is a step in the direction of cheapness without sacrificing efficiency. Fig. 326 represents the instrument with its cover and receiving funnel taken off.

In the centre is an eight-day clock with its upright spindle, bearing a small funnel with a horizontal tube which revolves once in twelve hours, passing successively over the mouth of the twelve compartments on the rim of the instrument. Beneath each compartment, which is funnel shaped, is placed a tube, as shown in Fig. 327.

The rain is received by the outer funnel, (Fig. 327), drips into the smaller revolving funnel, and running along the horizontal tube falls into the compartment corresponding to the hour of the day. So that all rain falling, for example, between two and three o'clock will be found in the tube marked 2.

In taking an observation the dome is taken off, the inner ring, with its twelve divisions is lifted out and each tube inspected, those that contain rain are lifted out, read off and the hour noted.

Each tube (Fig. 327) can contain half-an-inch of rain. Any overflow runs into a vessel beneath and can be measured, the tube which has overflown shows the hour.

	£	s.	d.
1276. **Stutter's self-recording Rain-Gauge,** with twelve divisions and tubes, requiring *two* daily observations .	6	6	0
1277. **Stutter's self-recording Rain-Gauge,** with twenty-four divisions and tubes, requiring but one daily observation	8	8	0
1278. **Stutter's self-recording Rain-Gauge,** with openings in the outer case for examining the tube without disjointing the instrument	9	9	0

HICKS' PATENT TERRESTRIAL RADIATION THERMOMETER.

The difficulty arising from the condensation of moisture in the outer cylinder of ordinary terrestrial minimum Thermometers, is, in this instrument, entirely obviated by simple but efficient means.

	£	s.	d.
1279. **Hicks' Patent Terrestrial Radiation Thermometer**	1	1	0

HICKS' NEW PATENT CLINICAL THERMOMETER.

The improvements introduced in this instrument have for their object the protection of the black in the figures and divisions, the rubbing out of which in all Clinical Thermometers hitherto in use, forms such a serious annoyance to the medical practitioner.

This is effected by the addition of an outer cylinder or thin glass jacket, which is hermetically sealed over the ordinary scale, thus forming an efficient shield and rendering the instrument absolutely perfect.

1280. **Hicks' New Patent Clinical Thermometer,** in boxwood or ebony cases, 3½-in., 4-in., 5-in. and 6-in., each	0	8	6

WORKS ON METEOROLOGY, &c.

Meteorological Essays—F. ARAGO, translated by SABINE .	0	10	0
Handy Book of Meteorology—A. BUCHAN, M.A., F.R.S.E.	0	8	6
The Law of Storms—DOVÈ, translated by R. H. SCOTT, F.R.S.	0	10	6
Practical Meteorology—J. DREW, 2nd Edition . . .	0	5	0
Weather Book—the late Admiral FITZROY	0	12	6
Hygrometrical Tables—J. GLAISHER, F.R.S. . . .	0	2	6
Corrections for Temperatures—J. GLAISHER, F.R.S. . .	0	1	6
Introductory Text Book of Meteorology—BUCHAN . .	0	4	6
Daily Range—J. GLAISHER, F.R.S.	0	1	6
Instructions for Meteorological Observations—Sir H. JAMES	0	7	6
Meteorology—KŒMTZ, translated by WALKER . . .	0	12	6
Winds and Currents—J. K. LAUGHTON	0	14	0
Treatise on Meteorology—ELIAS LOOMIS	0	12	0
Treatise on Meteorology—A. J. T. MORRIS	0	4	6
Physics and Meteorology—Professor MÜLLER . . .	0	10	6
On the Cause of Rain—G. A. ROWELL	0	5	0
Meteorological Tables—G. H. SIMMONDS	0	2	6
Connection of Physical Sciences—late Mrs. SOMERVILLE .	0	5	0
Sunshine and Showers—A. STEINMETZ	0	7	6
Weather Casts and Storm Prevision—R. STRACHAN . .	0	2	0
Monthly Meteorological Magazine . . . per year	0	5	0
Rain: how, when, where, why measured	0	2	0
Meteorological Register—G. J. SYMONS, F.M.S. per year	0	2	0
Barometer and Thermometer Diagrams . . per year	0	1	0
Rainfall Register (single sheet folio)	0	0	3
On Heat considered as a mode of Motion—TYNDALL . .	0	10	6

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